UNIVERSITY OF MISSISSIPPI MEDICAL CENTER

RADIATION SAFETY MANUAL

UMMC RADIATION SAFETY MANUAL

Developed by:

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And
Environmental Health and Safety

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Radiation Safety Manual

INTRODUCTION

Purpose

The purpose of this manual is to establish radiation safety policies for the University of Mississippi Medical Center (UMMC) and all programs affiliated with licenses and registrations of UMMC. This manual summarizes the procedures necessary to meet the requirements of the radioactive material license issued for human and non-human use of radioisotopes. This manual was developed with the assistance of the Radiation Safety Office, Radiation Safety Committee and appropriate legal counsel. This is hereby published as the official policy of UMMC for the use of radiation for diagnostic, therapeutic or investigational purposes. Adherence to the procedures, practices and recommendations described herein is essential if UMMC is to meet its obligation of providing a safe and healthful environment for our patients, visitors, students and personnel. All faculty, staff, employees and students engaged in work involving radioactive materials or radiation generating devices are expected to be familiar with and comply with the policies presented in this manual.

License

The Mississippi State Department of Health, Division of Radiological Health (MSDH/DRH) has issued a Medical Broad Scope License and other licenses and registrations authorizing the use of radioisotopes and radiation generating devices. MSDH/DRH has Nuclear Regulatory Commission (NRC) authority to enforce state regulations that comply with federal regulations. The Regulations for the Control of Radiation in Mississippi are approved by the Mississippi legislature and are state law. Licenses and registrations are issued to facilities and institutions in Mississippi who have submitted applications and corresponding policies and procedures that are followed to assure compliance with state regulations. This manual is submitted to MSDH/DRH with our application and, therefore, becomes part of our license. The Radiation Safety Committee and MSDH/DRH must approve changes to our license and manual. Non-compliance with our license can result in violations cited by MSDH/DRH during inspections of our radiation safety program. Serious violations that put patients, visitors, employees, students or our surrounding community at risk of excessive exposures to radiation can result in the loss of licenses and registrations to use radioactive materials or radiation generating devices.

ALARA CONCEPT

The ALARA concept is one involving every individual working around radiation and essentially means that each person must strive to maintain radiation exposures **A**s **L**ow **A**s **R**easonably **A**chievable. This is to reduce unnecessary exposure to themselves and/or others. Those persons authorized by UMMC to make its policies and direct its activities have the responsibility of seeing that the ALARA concept is applied to employees, visitors, students, and patients. This responsibility will be carried out through the following methods.

A. Encouragement of all employees to participate in the establishment, implementation and operation of the ALARA program as required by radiation safety policies, licenses and registrations, and state regulations.

B. Employee safety training in radiation work-related activities, which includes ALARA concepts.

C. Appropriate planning to ensure that any new facilities or equipment (or modifications of old facilities or equipment) that may affect radiation protection will be performed in consultation with the Radiation Safety Office.

D. Delegation of sufficient authority to the Radiation Safety Office to enforce regulations and administrative policies regarding radiation safety.

E. Continuing management evaluation of the radiation safety program through appropriate management reviews of personnel requirements, budget requirements, and operational efforts to maintain exposures ALARA.

A full copy of the ALARA Program can be viewed in Appendix B at the end of this manual. Printed copies are kept on file in the Radiation Safety Office.

INSTITUTIONAL RADIATION SAFETY COMMITTEE (RSC)

Structure

The Radiation Safety Committee membership must include an authorized user of each type of use permitted by the license, Radiation Safety Officer, a representative of the nursing service, and a representative of management who is neither an authorized user nor a Radiation Safety Officer. Other members will be appointed by the Vice Chancellor for Health Affairs, as he deems appropriate for equal representation of varying facets of institutional uses and needs.

The Radiation Safety Committee meets as often as necessary to conduct its business, but not less than once every six months. When the committee meets it is required that a quorum must be present. A quorum is defined, as any number greater than 50% of the appointed members, including the Radiation Safety Officer and the management's representative.

Authorities

The Radiation Safety Committee has the authority to implement policies governing the use of radioactive materials, radiation from radioactive materials, and radiation generating devices and enforce compliance with these policies.

Responsibilities

The Radiation Safety Committee shall:

A. Ensure that licensed material is used safely. This includes review as necessary of training programs, equipment, facility, supplies, and procedures;

B. Ensure that licensed material is used in compliance with the Mississippi State Board of Health, “Regulations for Control of Radiation In Mississippi” and the radioactive material license;

C. Ensure that the use of licensed material is consistent with the ALARA philosophy and program;

D. Establish a table of investigational levels for individual occupational radiation exposures; and

E. Identify program problems and solutions.

Duties

The Radiation Safety Committee shall:

A. Be familiar with all pertinent regulations, the license application, the license, and amendments;

B. Review the training and experience of the proposed authorized users, the Radiation Safety Officer, and medical physicists to determine that their qualifications are sufficient to enable the individuals to perform their duties safely and are in accordance with the regulations and the license;

C. Review on the basis of safety and approve or deny, consistent with the limitations of the regulations, the license, and the ALARA philosophy, all requests for authorization to use radioactive material within the institution;

D. Prescribe special conditions that will be required during a proposed method of use of radioactive material such as requirements for bioassays, physical examinations of users, and special monitoring procedures;

E. Establish a program to ensure that all persons whose duties may require them to work in or frequent areas where radioactive materials are used (e.g., nursing, security, housekeeping, physical plant) are appropriately instructed as required in the state regulations;

F. Review at least annually the Radiation Safety Office’s summary report of the entire radiation safety program to determine that all activities are being conducted safely, in accordance with the regulations and the conditions of the license, and consistent with the ALARA program and philosophy;

G. Recommend remedial action to correct any deficiencies identified in the radiation safety program;

H. Maintain written minutes of all Committee meetings, including members in attendance and members absent, discussions, actions, recommendations, decisions, and results of all votes taken;

I. Ensure that the radioactive material license is amended, if required, prior to any changes in facilities, equipment, policies, procedures, and personnel.

CHAIRMAN OF THE RADIATION SAFETY COMMITTEE

The Chairman of the Radiation Safety Committee shall serve as the administrative officer in promulgating the policies established by the committee.

Authorities

The Chairman of the Radiation Safety Committee shall have the authority to:

A. Issue temporary approvals to utilize sources of radiation based on properly submitted applications for use between meetings of the RSC, provided such approvals are reviewed by the RSC during the next committee meeting.

B. Temporarily limit or completely prohibit any further use of radiation sources by an individual when such use poses the possibility of a significant threat to the health of personnel, students, the public, or the environment - pending a hearing by the RSC at the earliest opportunity.

Duties

A. Keep a record of the actions taken in approving the use of sources of radiation, communications, and reports involved in the work of the RSC.

B. Act with the Radiation Safety Office (under policies established by the RSC) for the Committee between meetings and report such actions taken to the Committee for review at the next RSC meeting.

RADIATION SAFETY OFFICER

The Radiation Safety Officer will be responsible to the Director of the Department of Environmental Health and Safety and will act as a liaison between users of ionizing radiation and the Radiation Safety Committee. The Radiation Safety Officer or designee from radiation safety will keep the Radiation Safety Committee informed of matters affecting or involving the use of ionizing radiation at UMMC or any institutions affiliated with UMMC licenses and registrations.

The primary responsibility of all personnel in the Radiation Safety Office is to advise and assist personnel in matters concerning the use of ionizing radiation and radiation safety. Problems concerning the use of radiation will be initially dealt with between radiation safety staff and the individual with whom the problem has arisen. If further actions are required, the individual's supervisor and the Chairman of the RSC will be asked to assist with a resolution to the problem. The Radiation Safety Committee (RSC) and the Director of the Department of Environmental Health and Safety will be informed and will be asked to enforce corrective or disciplinary action if necessary. Disciplinary actions may include, but are not limited to, warnings by radiation safety office staff; the institution of supervision by another authorized user; and partial or full revocation of privileges to use radioactive materials or radiation generating devices. Termination of an employee will be requested if the severity of the problem warrants such actions.

Authorities

A. Make necessary immediate safety decisions, in accordance with the rules and procedures established by the RSC, as well as the Regulations.

B. Ensure compliance with all aspects of this manual and the Regulations by all personnel and individuals assigned to supervise the use of radiation or radiation generating devices.

   1. In the event of a conflict between the Radiation Safety Office and a department official, the Chairman of the RSC may elect to call a meeting of the entire RSC to resolve the matter, and the decision will be recorded.

   2. In the event of a conflict between the Radiation Safety Office and the RSC in policy matters not covered in this manual or the Regulations, the matter will be referred to the Vice Chancellor for resolution, and the decision recorded.

C. Issue temporary approvals to utilize sources of radiation, based on properly submitted applications for use between meetings of the RSC provided such approvals are reviewed by the RSC during the next committee meeting.

Responsibilities

A. Over-all administrative direction of the Radiation Safety Program for UMMC.

B. Advise the RSC in establishing radiation safety policy as it applies specifically to UMMC.

C. Act as a liaison between the Division of Radiological Health and UMMC.

D. Produce and circulate radiation safety procedures.

E. Ensure compliance with the conditions of all licenses and registrations, this manual, and the Regulations.

Duties

A. Ensure that unsafe activities involving radioactive materials or radiation generating devices are stopped;

B. Maintain documentation that demonstrates that the dose to individual members of the public does not exceed the limit specified in state and federal regulations and complies with ALARA principles;

C. Ensure that up-to-date radiation protection procedures in the daily operation of the radiation safety program are developed, distributed, and implemented;

D. Ensure that the possession, use, and storage of licensed material is consistent with the limitations in the license, the regulations, the SSDR certificates, and the manufacturer’s recommendations and instructions;

E. Ensure that individuals installing, relocating, maintaining, adjusting, or repairing devices containing sealed sources are trained and authorized by an NRC or Agreement State license;

F. Ensure personnel training is conducted and is commensurate with duties regarding licensed material;

G. Documentation is maintained to demonstrate that individuals are not likely to receive, in one year, a radiation dose in excess of 10% of allowable limits or that personnel monitoring devices are provided;

H. Ensure that when necessary, personnel monitoring devices are used and exchanged at the proper intervals, and records of the results of such monitoring are maintained;

I. Ensure that licensed material is properly secured;

J. Ensure that documentation is maintained to demonstrate, by measurement or calculation, that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual limit for members of the public;

K. Ensure the notification of proper authorities of incidents such as loss or theft of licensed material, damage to or malfunction of sealed sources, and fire;

L. Ensure recordable events and misadministrations are investigated and reported to the Mississippi Department of Health/Division of Radiological Health, and cause(s) and appropriate corrective action(s) are identified, and timely corrective action(s) are taken;

M. Audit the radiation protection program at least annually and document the audit;

N. Ensure that if violations of regulations, license conditions, or program weaknesses are identified, effective corrective actions are developed, implemented, and documented;

O. Ensure that licensed material is transported, or offered for transport, in accordance with all applicable DOT requirements;

P. Ensure licensed material is disposed of properly;

Q. Ensure appropriate records are maintained;

R. Ensure an up-to-date license is maintained and amendment and renewal requests are submitted in a timely manner.

RESPONSIBILITIES OF DEPARTMENT CHAIRMEN, DEANS, AND ADMINISTRATORS

Department Chairmen, Deans, Directors of Research Institutes or Centers, as Administrators are responsible for the general safety of faculty, staff, and students working with radiation in their overall area of jurisdiction. It shall be emphasized that this responsibility is reduced in no way by activities of the Radiation Safety Committee or the Radiation Safety Office.

Administrators shall ensure that the principal investigators in their areas of jurisdiction are provided with appropriate safety policies and procedures and shall stress the importance of compliance with the guidelines described therein.

Administrators are mutually responsible, with the principal investigators or authorized users, for informing the Radiation Safety Office of work involving radiation and reporting accidents or incidents involving radiation to the Radiation Safety Office.

The Department Chairmen and the faculty members who supervise teaching laboratories are mutually responsible for informing students of proper precautions to be taken when working with radiation.

RESPONSIBILITIES OF THE AUTHORIZED USER

An authorized user uses or directly supervises the use of licensed material or registered devices. To be an authorized user training and experience must meet the criteria of The Regulations for the Control of Radiation in Mississippi. For the use of licensed materials for diagnostic or therapeutic purposes an applicant must show himself to be qualified and approved by a recognized accrediting or licensing body. For research programs an applicant will be approved by the Radiation Safety Committee based upon training and experience to use the material in question for the purpose(s) requested. Training and experience must be proven to use radiation generating devices. Authorized user status is granted after the applicant has been approved by the Radiation Safety Committee to use or supervise the use of licensed material or registered devices.

Authorities

A. Although the authorized user may delegate specific tasks to supervised personnel, he/she is responsible for the safe use of radioactive materials, radioactive sources, or radiation-generating devices.

B. Using radioactive materials, sources or x-ray generating devices in a safe manner that is compliant with licenses and registrations and with federal and state regulations.

Responsibilities

A. Ensuring that all radioactive material, radioactive sources, or x-ray generating devices are being used under the conditions and terms of the license or registration and is used in accordance with all appropriate rules and regulations, including the Radiation Safety Manual.

B. Notifying the Radiation Safety Office and Radiation Safety Committee of any proposed changes in protocols, procedures, equipment, licensed materials, etc. approved by the Radiation Safety Committee and obtaining Radiation Safety Committee approval prior to implementing any proposed changes.

C. Ensuring that the training of personnel working with ionizing radiation is adequate and in accordance with regulatory requirements. This includes the requirement for initial and annual training.

D. Ensuring that ALARA principles are practiced and adhered to in all areas where ionizing radiation is being used under the authorized user's supervision.

E. Submitting proposals for new procedures involving the use of ionizing radiation to the Radiation Safety Office for submission to MSDH/DRH when necessary and/or the Radiation Safety Committee for approval.

F. Notifying the Radiation Safety Office immediately of any incident, recordable event or misadministration.

RESPONSIBILITIES OF INDIVIDUAL USERS

An INDIVIDUAL user is classified as any of the physicians, scientists, and other professional and technical workers engaged in patient care, clinical and laboratory research, and research support activities which involve actual use and handling of materials and devices producing ionizing radiation. These personnel usually work under the supervision of the authorized user. The success of the radiation safety program depends on the individual's thoughtfulness and care in handling radioisotopes and devices producing ionizing radiation.

The individual user is responsible for the following:

A. Complying with the Radiation Safety Manual, applicable regulations, license conditions, and safety procedures of the authorized user, protocols, and any administrative control that may apply to the work being done.

B. Using all appropriate protection and security measures for the safe use, storage, transfer, and disposal of the material, machine, or device.

C. Reporting any defective equipment to the supervisor or the Radiation Safety Office.

D. Immediate notification of the Radiation Safety Office in the event of an emergency or of a situation that may create a radiological safety hazard and carrying out recommended action and/or corrective measures.

E. If required, wearing of an applicable dosimeter in a location on the body that will give the most accurate measurement of radiation exposure and wearing it at all times while working in the presence of ionizing radiation. Keep exposures as low as possible.

F. Reporting immediately to the supervisor and to the Radiation Safety Office any lost or stolen materials or equipment that produce or generate ionizing radiation.

G. Wearing appropriate protective equipment, such as lead aprons, to assure exposure to radiation is as low as possible.

Applying for Authorization to Use Radioactive Material

Under a broad scope license the authority to control the use of radioactive materials or sources and equipment that generate radiation within this institution is vested in the institutional Radiation Safety Committee (RSC). Persons requiring information concerning the use of radioactive materials should call the Radiation Safety Office for guidance.

A. Personnel with prior approval

Those desiring to modify their approval must either submit a memo to the Radiation Safety Office indicating the change requested and a brief description of how the radioactive material will be used; or obtain an Application for Authorization to Use Radioactive Materials from the Radiation Safety Office, download it from the EHS web page or copy it from this manual. The completed form must be returned to the Radiation Safety Office for submission to the Radiation Safety Committee.

B. New Personnel

Persons applying for approval to use radioactive material or radiation sources for the first time must obtain an Application for Authorization to Use Radioactive Materials for diagnostic or therapeutic uses or an Application for Authorization to Use Radioactive Materials for Research Purposes from the Radiation Safety Office, or download it from the EHS web page or copy it from this manual. When completed, this form must be returned to the Radiation Safety Office for submission to the Radiation Safety Committee. Approval for the use of radioactive material or radiation sources will be based upon:

1. Fulfillment of training and experience requirements established in The Regulations for the Control of Radiation in Mississippi, www.msdh.state.ms.us and Nuclear Regulatory Commission (NRC) guidelines. The minimum guidelines shall include, but shall not be limited to, adequate formal training and/or experience in the safe handling of radioisotopes, radiation dose units and biological hazards of radiation, and characteristics of ionizing radiation.

2. The applicant's agreement in writing to follow all UMMC, state, and federal requirements governing the use of radioactive materials and to accept all responsibility for personal injury resulting from failure to comply with such requirements.

RADIATION EXPOSURE PROTECTION AND MONITORING

Personnel monitoring is required when it is likely that an individual will receive a total effective radiation dose in excess of ten percent of the annual limits, given in the following paragraphs. The total effective dose includes a summation of the separate exposures from internal dose as well as external dose.

Normally, exposure from radiation sources external to the body will be determined through the use of monitoring devices worn by the individual. These will be whole body monitors to measure several components of a radiation exposure. The deep dose reading, which results from the penetrating component of a radiation field, is the most important measurement. The shallow dose component reading is essentially a determination of the amount of exposure received by the skin of the whole body. If a monitor is worn close to the head of the body, the lens dose reading is a determination of the exposure received by the lens of the eye.

Exposures due to uptakes of radioisotopes into the body will be determined from measurement of biological samples and/or partial body counting of radiation emitted from within the body. The

Radiation Safety Office, through a review of the situation and the applicable regulatory requirements, will determine the need for the various types of monitoring.

The method of monitoring in each group, whether internal or external, will be determined at the time applications for radiation use are reviewed; however, the monitoring requirements for an individual will be reviewed and, if necessary, changed at any time by the Radiation Safety Office. If an authorized user or individual user believes that monitoring is necessary, then such monitoring will be provided initially and the results as to the need for further monitoring evaluated by the Radiation Safety Office. If such monitoring is completely unnecessary, it will be brought to the Authorized User's attention and monitoring may be discontinued.

It is UMMC's policy to maintain worker exposure to sources of ionizing radiation as low as is reasonably achievable – ALARA. The permissible dose requirements of state and federal regulations will be followed with regard to worker exposures and exposures to members of the public. These maximum allowable exposure values are provided below.

Adult Occupational Exposures

Adults who are likely to receive an annual dose in excess of any of the following (each evaluated separately) will be required to wear a personal dosimetry device.

- 5 mSv (0.5 rem) deep-dose equivalent
- 15 mSv (1.5 rems) eye dose equivalent
- 50 mSv (5 rems) shallow-dose equivalent to the skin
- 50 mSv (5 rems) shallow-dose equivalent to any extremity

Maximum permissible occupational exposures for adult employees are:

- 50 mSv (5 rem) deep-dose equivalent
- 150 mSv (15 rems) eye dose equivalent
- 500 mSv (50 rems) shallow-dose equivalent to the skin
- 500 mSv (50 rems) shallow-dose equivalent to any extremity

Exposures to Minors

Minors, under the age of 18, who are likely to receive an annual dose in excess of any of the following (each evaluated separately), will be required to wear a personal dosimetry device.

- 0.5 mSv (0.05 rem) deep-dose equivalent
- 1.5 mSv (0.15 rems) eye dose equivalent
- 5 mSv (0.5 rems) shallow-dose equivalent to the skin
- 5 mSv (0.5 rems) shallow-dose equivalent to any extremity

Maximum permissible occupational exposures for an employee who is a minor are:

- 5 mSv (0.5 rem) deep-dose equivalent
- 15 mSv (1.5 rems) eye dose equivalent
- 50 mSv (5 rems) shallow-dose equivalent to the skin
- 50 mSv (5 rems) shallow-dose equivalent to any extremity

Declared Pregnant Workers

Declared pregnant women who are likely to receive an annual dose from occupational exposures in excess of 0.5 mSv (0.05 rem) deep-dose equivalent will be required to wear a personal dosimetry device and a fetal monitor. Fetal exposure limits are listed below:

- 5 mSv (0.5 rem) deep-dose equivalent for the duration of gestation period
- 0.5 mSv (0.05 rem) deep-dose equivalent in any one month of monitoring

NOTE: Female employees who wish to declare their pregnancy must complete a Declaration of Pregnancy form and return it to the Radiation Safety Office. Once this form has been completed, training information will be provided and a fetal dosimetry device will be ordered.

Ordering Personal Dosimetry Devices

Departments are required to notify the Radiation Safety Office if employees in the area are likely to receive exposures to radiation in excess of 10% of the annual limits noted above. If in doubt, contact the Radiation Safety Office for a consultation to determine the risk.

Departments are also required to designate a specific individual to be responsible for:

A. Collecting the necessary information and making arrangements with the Radiation Safety Office to order dosimetry devices for departmental employees (See Order/Terminate Form and Occupational Exposure History Form);

B. Maintaining copies of departmental exposure reports;

C. Posting copies of exposure reports or making them available to all employees within the department;

D. Distributing dosimetry devices to departmental employees as they are provided by the Radiation Safety Office from the vendor;

E. Collecting dosimetry devices from departmental employees to return to the Radiation Safety Office for shipment to the vendor for processing;

F. Keeping control badges in low background areas and assuring the controls are returned to the vendor with the appropriate personnel badges;

G. Issuing "spare" badges to new employees or employees who have reported losing a badge, maintaining a record of which employees the "spare" badges were issued to and when and providing the Radiation Safety Office with this information;

H. Notifying the Radiation Safety Office upon termination of employees receiving personal dosimetry devices (using the Order/Terminate Form); and

I. Forwarding any requests for employee radiation exposure histories (from employers or employees) to the Radiation Safety Office for action.

Individuals issued personal dosimetry devices must:

A. Wear the personal dosimetry devices in appropriate locations and conditions;

B. Wear only the dosimetry device assigned specifically to them and bearing their name or a spare badge if one has been issued;

C. Return each dosimetry device at the end of the monitoring period to the departmental badge manager for return to the Radiation Safety Office. **Note:** It is the individual dosimetry wearer's responsibility to arrange returns despite vacations, personal leave or shift hours. The departmental badge manager is expected to contact delinquent individuals in efforts to collect the badges not returned, but they are not expected to chase people down to get them; and

D. Report any lost dosimetry devices immediately to the departmental badge manager or the Radiation Safety Office.

    1. For lost dosimetry badges the Radiation Safety Office will make arrangements with the vendor to assign an estimated exposure based on an average of prior exposures. Repeated lost badges will cause an inaccurate estimation of exposure to radiation.

    2. Repeated losses of dosimetry devices and continued failure to return dosimetry devices for processing will result in written notification of departmental administration (manager, chairman, etc.) and notification of Human Resources as a matter of non-compliance with safety policies.

Proper Use of Personal Dosimetry Devices

All personal dosimetry devices designed for whole-body monitoring must be worn on the front portion of the upper body (area of the internal organs and eyes) and must be worn outside any protective shields (such as lead aprons) worn on the body.

Declared pregnant individuals working in areas where radioactive materials or x-ray generating devices are used (and stored in the case of radioactive materials) shall be provided a whole-body personal dosimetry device and a fetal monitoring dosimetry device.

A. The whole-body personal dosimetry device must be worn on the front portion of the upper body and must be placed on the outside of any protective shields worn on the body. When using two badges to determine the whole-body exposure, one badge will be placed outside the apron at the collar and the other under the apron at the waist line.

B. The fetal monitoring dosimetry device must be worn on the front of the lower abdomen underneath any protective shields (such as lead aprons) to obtain exposures potentially received only by the fetus.

Personal dosimetry devices in the form of rings will be issued to employees whose hands are at increased risk of exposure in comparison to the whole body.

A. Ring dosimetry devices must be worn by employees who are handling or manipulating unsealed or unshielded sources with tongs or forceps or who are holding partially shielded containers of radioactive material with their hands, if the potential for exceeding 10% of the annual limit exists.

B. At the discretion of the Radiation Safety Office, ring dosimetry devices will be required for monitoring exposures to the hands of individuals using high-energy beta emitting isotopes. This decision will be based on the isotope, activity, and procedures used by the individual.

C. Ring dosimetry devices must be worn on the hand expected to receive the highest dose if only one is issued and be oriented facing the radiation source. The ring(s) must be returned for analysis along with the whole body dosimetry device.

Internal Monitoring

Thyroid bioassays will be required after the use of radioiodine if certain conditions apply, as noted below. Thyroid bioassays shall be obtained between 6 and 72 hours following work with radioiodine in excess of the quantities listed below. Scheduling of the monitoring will be done through the Radiation Safety Office.

A. Conditions under which thyroid bioassay is necessary.

1. Routine bioassay is necessary when individuals handle quantities of radioactive iodine that exceed those listed below.

a. The condition of our license requiring bioassays states that individuals involved in frequent operations (less than every two weeks) which utilize, during any one (1) quarter, ten (10) millicuries of Iodine-125 and/or Iodine-131 in capsule form or a total of (1) millicurie of liquid Iodine-125 and/or Iodine-131 must have a bioassay performed within six (6) to seventy-two (72) hours following the use of the licensed material. Infrequent use of Iodine-125 and/or Iodine-131 (greater than every two weeks) will necessitate a bioassay within ten (10) days following the use of the licensed material. Bioassays may be either in vivo or in virto measurements; however, the licensee must maintain on file bioassay procedures results for review by the MSDH/DRH.

b. In accordance with NRC Regulatory Guide 8.9, “Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program”, Revision 1, July 1993, periodic bioassays, such as quarterly, may be required of personnel working with radioiodine but not likely to receive more than 10% of the ALI

in a calendar year. This determination will be made based on previous bioassay results for personnel performing the same or very similar procedures.

c. In those laboratories working only with I-125 radioimmunoassay (RIA) kits, the quantities of I-125 are very small and will not meet the requirements for bioassays. Thyroid monitoring is not required.

2. In those instances where there is some doubt as to the volatile/dispersible nature of the iodine used, the regularity of work with activities requiring bioassays, or the proximity of workers to iodine use areas, the Radiation Safety Office has the authority to require at least annual bioassays of workers in order to document safe working conditions.

B. Evaluation and investigational levels and corresponding actions

1. Whenever the thyroid burden at the time of measurement exceeds 2% of the Annual Limit on Intake (ALI), which equals 1.2 microcuries of I-125 or 1 microcurie of I-131, the following **evaluation** actions must be taken:

a. Determine the causes of exposure and evaluate the potential for further exposures. If further exposure is expected, it will be necessary to restrict the worker from the area until the problem is corrected.

b. A repeat bioassay shall be taken within 2 weeks of the previous measurement and shall be evaluated within 24 hours after the measurement.

c. Reports or notification must be provided as required by the regulations.

d. **Note:** The ALI for I-131 is 50 uCi inhalation and for I-125 is 60 uCi inhalation.

2. If the thyroid burden at any time exceeds 10 % of the Annual Limit on Intake (ALI), which equals 6 microcuries of I-125 or 5 microcuries of I-131, the following **investigational** actions must be taken:

a. Carry out all steps as described in part 1.a. above.

b. As soon as possible, refer the case to appropriate medical consultation for recommendations regarding therapeutic procedures that can be carried out to accelerate removal of radioiodine from the body. If possible, this will be done within 2-3 hours after exposure so that a thyroid-blocking agent would be effective.

c. Perform repeated measurements at weekly intervals until the thyroid burden is less than 1.2 microcuries of I-125 or 1 microcurie of I-131.

C. Conditions under which urine bioassay is necessary

1. Individuals involved in operations that utilize more than 100 millicuries of hydrogen-3 (tritium) in a non-contained form (other than metallic foil), within a

30-day period shall have bioassays performed within one week following a single operation.

2. Individuals believed to have ingested or inhaled significant amounts of a tritium compound from an accident or incident will be required to provide a urine sample for determination of exposure.

LABELING AND POSTING

The Radiation Safety Office provides all required signs and labels.

Notices

A. In areas where employees are working around x-ray generating devices, the following items must be posted:

1. "Notice to Employees" sign (RH-5) must be posted in a conspicuous location (contact the Radiation Safety Office to obtain a copy).

2. Appropriate operating procedures must be posted.

B. In areas where employees are working around radioactive material, the following items must be posted (contact the Radiation Safety Office to obtain any of these signs):

1. "Notice to Employees" sign (RH-5) must be posted in a conspicuous location.

2. "Emergency Procedures for Spills Involving Radioactive Materials"

3. "Reminder of Good Radioisotope Laboratory Safety Practices"

4. Sign specifying "No Eating Drinking or Smoking in This Area"

Caution Signs

The conventional magenta or black and yellow three-blade design caution sign must be posted in areas described below (contact the Radiation Safety Office to obtain any of these signs):

A. Any radiation area where a major portion of the body, head, eyes, or gonads is likely to receive in any one hour a dose in excess of 100 mrem (0.1 sievert) shall be posted with a sign containing the conventional radiation symbol and the words "Caution High Radiation Area". These signs shall be posted so that they can be seen and read from any entrance to the high radiation area.

B. Any radiation area where a major portion of the body, head, eyes, or gonads is likely to receive in any one hour an exposure of 5 mrem (0.5 sievert) is a "Radiation Area" and it shall be posted with a sign containing the conventional radiation symbol and the words "Caution Radiation Area". These signs shall be posted so that they can be seen and read from any entrance to the radiation area.

C. Airborne radioactivity areas must be posted with a sign bearing the radiation caution symbol and the words "Caution (or Danger) Airborne Radioactivity Area".

D. Each area, room, hood or incubator in which radioactive material is used or stored in an amount exceeding the quantity of radioactive material specified in the "Regulations for Control of Radioactive Material in Mississippi" must be posted with a sign bearing the radiation caution symbol and the words "Caution (or Danger) Radioactive Materials".

E. Each refrigerator or freezer where radioactive material is stored or used is to be posted with a sign stating "Caution Radioactive Material No Food or Beverage May Be Stored In This Unit".

F. Each laboratory waste container used to temporarily store radioactive waste (until transferred to a waste drum) shall be labeled with a sign stating "Caution Radioactive Material Do Not Empty".

G. Each sink used for liquid waste disposal or cleaning of contaminated glassware shall be posted with a sign stating "Caution Radioactive Waste Disposal Sink".

H. Each room housing a x-ray device used for research purposes shall:

1. Be posted with a sign stating "Caution X-rays - This Equipment Produces X-rays When Energized".

2. Have the device control panel labeled "Caution X-rays – This Equipment Produces X-rays When Energized".

I. Containers of radioactive materials must be labeled to identify the radioactive contents.

1. The label must bear the radiation caution symbol and the words "Caution (or Danger) Radioactive Material".

2. Prior to the disposal of an empty uncontaminated container or relocation to unrestricted areas, the radioactive material label must be removed or made illegible to indicate that the container no longer contains radioactive material. The Radiation Safety Office must be contacted to verify that items in a restricted area are not contaminated prior to removing the label and relocation of the item to an unrestricted area.

Work Station Setup

Each workstation where radioactive materials are used is a potentially contaminated area. Therefore, all workstations shall be clearly identified by all persons entering the area.

A. All workstations where radioactive material is used shall be lined with plastic-backed absorbent paper.

B. Any and all equipment used during procedures involving radioactive materials shall be tagged with some form of identification of potential contamination, whether it is a "Caution Internal Contamination" tag obtained from the Radiation Safety Office or the application of "Caution Radioactive Material" tape.

C. Containers for radioactive waste collection will be placed in a location such that employees will not have to leave the workstation to dispose of radioactive wastes during a procedure. These temporary waste containers will be identified as radioactive waste with the "Caution Radioactive Waste Do Not Empty" label if they are placed on the floor. Bench top containers will be labeled with waste signs or with tape that states "Caution Radioactive Material".

D. Workstations shall, if at all possible, be set in locations near a sink, or in an area where a sink is readily available.

PROCUREMENT OF RADIOACTIVE MATERIALS

Only authorized users are permitted to procure or purchase radioactive materials exceeding exempt quantities. Authorized users may order only those radioisotopes and quantities for which they are currently approved.

The NRC requires that all commercial and non-commercial shippers have documentation indicating that recipients are authorized to possess the type and quantity of radioactive material requested. Presently, all companies providing radioactive materials to UMMC possess a copy of the facility's broad scope license. Copies of this license will be sent to all suppliers upon request. UMMC will request a copy of all commercial and non-commercial entities' radioactive material license(s) before shipping any radioactive materials to the entity.

Radioactive materials are classified as hazardous materials and are subject to the federal and state requirements regarding the tracking of hazardous materials. This is accomplished by using a computer-generated list of all radioactive materials ordered and shipped to UMMC from suppliers. In order to maintain this computer receipt list (and facility inventory), the following procedures must be observed when completing a standard purchase requisition to order radioactive material:

Procedures for Purchasing Radioactive Materials

A. Radioactive material purchase order requisitions must identify the isotope (i.e. Tc-99m, Tl-201, I-131, etc.) and the activity expressed in millicuries (mCi) or microcuries (uCi). If this information is not readily available to the Radiation Safety Office via Lawson, a phone call or email will be generated in order to determine the activity and isotope being ordered.

B. If the order is being placed in Lawson by someone other than the authorized user, the Radiation Safety Office must be informed of which authorized user the material is being purchased for.

C. The Radiation Safety Office will review requests, ensure that only individuals approved by the Radiation Safety Committee request radioactive material, and verify that isotopes ordered are those approved by the RSC. The Radiation Safety Office will then approve the order in Lawson.

Package Surveys

Packages delivered to the Shipping and Receiving Department are surveyed by the Radiation Safety Office prior to delivery to the laboratory. The packages will have been opened, the date of the receipt survey and the initials of the surveyor will be noted on the outside of the package, and the radiation symbols on the outer shipping container will have been defaced prior to delivery to the lab. If a package is received by laboratory personnel without the above indications that surveys were completed please contact the Radiation Safety Office immediately for the completion of the receipt survey.

Nuclear Medicine/Nuclear Cardiology/PET personnel shall survey all incoming packages from the radiopharmacy. The monitoring shall be performed as soon as practicable after receipt of the package, but no later than three (3) hours after the package is received if received during normal working hours. If the package was received after working hours the package survey shall be performed no later than three (3) hours from the beginning of the next working day.

A. Package Survey Procedures

1. Visually inspect the package for any sign of damage (e.g., wetness, crushed).

a. If damage is noted, the survey procedure will be halted and the following steps taken:

1) Restrict further access to the package.

2) Using gloves, swipe the exterior of the package and measure the swipe activity with a thin window GM tube survey meter for radiation levels above twice background levels.

3) If negative, proceed with package survey.

4) If positive:

a) Place the package in a plastic bag and relocate to a shielded area for examination and eventual return to the radiopharmacy.

b) Survey all areas and workers (including clothing) that came into contact with the package. Decontaminate, if necessary, to background levels.

c) Contact the Radiation Safety Office, the radiopharmacy, and the carrier as soon as possible and provide contamination details.

b. If the package appears to be undamaged upon visual inspection:

1) Measure the radiation exposure rate at one (1) meter from the package surface and record. If greater than 10 mR/hr, stop the procedure and notify the Radiation Safety Office.

2) Measure the exposure rate at the surface and record. If greater than 200 mR/hr, stop the procedure, place in a shielded area, and notify the Radiation Safety Office.

3) Put on gloves.

4) Swipe the outer surface of the container and measure the swipe activity with a thin window GM tube survey meter. If greater than twice background levels, take corrective actions as applicable.

5) Open the outer package (following manufacturer's directions, if supplied) and remove packing slip. Verify the contents (using the packing slip) and check the integrity of the inner container by inspecting for breakage of seals, loss of contents, or discoloration of packaging material.

6) Swipe the external surface of the inner container and measure the activity of the swipe with a thin window GM tube survey meter. If greater than twice background levels, stop and take corrective actions as applicable. Swipes of packages containing H-3 and C-14 should be analyzed using a liquid scintillation counter (LSC).

Documentation of Package Surveys

A record of the results of all package surveys and corrective actions taken, if necessary, shall be made. These records shall be made available for review by the Radiation Safety Office and MSDH/DRH for three (3) years.

SURVEY INSTRUMENTATION

All areas where radioactive materials are used or stored must have access to survey instrumentation. This instrumentation must be maintained in proper working condition or taken out of service and replaced. All survey meters must be registered with the Radiation Safety Office.

Calibration

Survey meters must be calibrated with a radionuclide source or calibrated pulser and check sources at least annually and following repair.

A. The source shall be an approximate point source.

B. The source activity shall be traceable within 5% accuracy to the National Institute of Standards and Technology (NIST) calibrations.

C. Calibration for linear readout instruments shall be performed at two points on each scale. The two points shall be approximately $\frac{1}{3}$ and $\frac{2}{3}$ of full scale. Logarithmic scale and digital instruments will be checked at mid-range of each decade and at two (2) points of at least one decade.

D. The exposure rate measured by a linear readout meter shall differ from the true exposure rate by less than 10% of full scale or the meter manual will be used to make the necessary adjustments to bring the meter into calibration. Readings within ± 20% will be considered acceptable, if a calibration chart or graph is prepared and attached to the meter. Instruments designed to read out in units of neutron dose equivalent or dose equivalent rate shall be calibrated with an accuracy of 30% for ranges from 0-10 mR/hr and 20% accuracy for ranges from 10 mR/hr and above.

E. Survey meters used for contamination control in laboratories with readouts in cpm or cps will be checked for proper operation by:

1. Using a pulse meter to test meter circuits; and

2. Using a calibration check source to test the function of the meter probe (providing a reference for comparison against previous and subsequent operational checks).

F. The manufacturer, an authorized consultant, an outside firm, or the licensee shall perform calibrations.

G. Each calibrated survey meter will possess a calibration certificate on file in the Radiation Safety Office. A copy of the calibration certificate will be supplied to the instrument user if requested.

Choosing Appropriate Instrumentation

A. All meters will not detect all radioisotopes. The following guidelines are designed to assist in selecting meters that are appropriate for detecting various types of radiation:

B. For detecting beta emitters with maximum beta energy of greater than or equal to 150 keV such as C-14, S-35, or P-32, use of the following are recommended:

1. A portable meter with a GM tube is required for personnel surveys and continuous surveying throughout procedures requiring the use of radiation. A Geiger-Mueller (GM) with a maximum window thickness of 1.7 mg/cm^2 is required. Pancake-style GM's are recommended over thin end window GM's because pancake-style GM's are generally more efficient for low energy beta emitters (such as C-14 or S-35), and the pancake's larger window surface area makes it easier to monitor large areas for contamination.

2. Surveys of laboratory surfaces, as required monthly can be completed with the use of a liquid scintillation counter. The efficiency of a liquid scintillation counter is generally higher than a pancake probe and lower removable contamination levels can be determined with the use of smears or swipes of surfaces.

C. For detecting beta emitters with maximum beta energies of less than 150 keV, such as H-3, a liquid scintillation counter is the only detector that can be used.

D. For surveying radiation sources which generate x- or gamma rays with energies greater than 30 keV, a GM pancake, GM thin end window, or a GM side window detector is usually adequate. As mentioned above, the pancake-style is preferable since it has a

larger window surface area, which assists in monitoring large areas for contamination. However, solid detectors (i.e. NaI) are usually much more efficient and may be more appropriate if very low levels of radiation need to be detected.

E. For surveying for radiation sources which generate x- or gamma rays with energies less than 30 keV (i.e. I-125), a thin window NaI scintillation detector is recommended. A standard GM tube has very low efficiency for this energy range and should not be the primary survey instrument of choice.

Note: If two probes are used for the same survey meter, calibration with both probes is required.

F. Dose rate measurements for x- and gamma radiation fields should be taken with ion chambers. They have an energy independent response and are therefore recommended for any dose rate measurements. Energy compensated probes for survey meters may be used for dose rate measurements, but the instrument must be calibrated with that particular probe.

Proper Use of Portable Survey Instruments

A. Select appropriate survey instrument and detector.

B. Perform battery check or battery test.

C. Verify calibration date is within the last year.

D. Set meter to slow response with audio on (if audio available).

E. Remove all covering from probe that may interfere with detection (if probe may become contaminated it is advisable to cover the probe with some form or protection that will not reduce the efficiency of detection capabilities of the probe for the isotope in use).

F. Set meter on lowest scale setting.

G. Establish a background reading in a clean area and record on survey form.

H. Hold probe close to the surface of an object or area being surveyed and move slowly across the surface at a consistent distance and speed (approximately 1/2" from the surface at a rate of 1-2 inches per second).

I. If survey instrument dial exceeds maximum level on lowest scale, turn the dial to the next scale and survey area again. Repeat until the readings do not exceed the maximum level of the scale in use.

J. Document meter readings on survey reports, multiplying meter reading by the scale setting used. Record the survey results in either:

1. Counts per minute (cpm). (If survey results are greater than twice background, clean and resurvey.)

2. Disintegrations per minute (dpm). (If survey results are greater than 200 dpm, clean and resurvey.)

    a. To convert from cpm to dpm use the following formula

        dpm = net cpm/efficiency

    b. Typical efficiencies to use for conversion with the use of a pancake probe are as follows:

        1) P-32 = 0.20 (20%)

        2) S-35 = 0.03 (3%)

        3) P-33 = 0.03 (3%)

        4) Ca-45 = 0.10 (10%)

        5) C-14 = 0.06 (6%)

        6) I-125 = 0.01 (1%)

        7) Tc-99m = 0.01 (1%)

    c. If the survey meter being used reads in counts per second (cps) multiply by 60 to get counts per minute (cpm).

DOSE CALIBRATORS

Nuclear Medicine/Nuclear Cardiology/PET departments authorized to administer radiopharmaceuticals should possess a dose calibrator and use it to measure the amount of activity administered to each patient.

Dose calibrator reference and calibration sources traceable to the National Institute of Standards and Technology (NIST), or other standards recognized as being equivalent by the NIST shall be used for calibrations.

Qualified UMMC or radiopharmacy personnel shall perform quality control checks and tests on all dose calibrators used for measuring the amount of activity administered to a patient. These tests shall include:

Constancy Checks

A. Checking each dose calibrator for constancy with a dedicated check source at the beginning of each day of use.

B. Checks shall be done on a frequently used setting with a sealed source of not less than 50 microcuries with energies representative of the radionuclides in clinical use.

C. Records of these checks shall include:

    1. The model and serial number of the dose calibrator;

2. The identity and calibrated activity of the radionuclide contained in the check source;

3. The date of the check;

4. The activity measured;

5. The instrument settings; and

6. The initials of the individual who performed the check.

D. Records of these checks shall be retained for three (3) years.

Accuracy Checks

A. Testing each dose calibrator for accuracy is required upon installation and at intervals not to exceed 12 months thereafter.

B. Checks are completed by assaying at least 2 sealed sources containing different radionuclides, the activity of which the manufacturer has determined to be within ± 5 percent of the stated activity, with minimum activity of 50 microcuries and energies representative of the radionuclides in clinical use.

C. Records shall include:

1. The model and serial number of the dose calibrator;

2. The model and serial number of each source used;

3. The identity of the radionuclide contained in the source and its activity;

4. The date of the test;

5. The results of the test;

6. The instrument settings; and

7. The signature of the Radiation Safety Officer.

D. Records of each accuracy test shall be retained for three (3) years.

Linearity Checks

A. Testing of each dose calibrator for linearity is required upon installation and at intervals not to exceed 3 months thereafter.

B. Testing shall be completed over the range of use between 30 microcuries and the highest dosage that will be assayed.

C. Records shall include:

1. The model and serial number of the dose calibrator;

2. The calculated activities:

3. The measured activities;

4. The date of the test; and

5. The signature of the Radiation Safety Officer.

D. Records of each linearity test shall be retained for three (3) years.

Geometry Dependence Testing

A. Testing each dose calibrator for geometry dependence is required upon installation, to include the range of volumes and volume configurations for which it will be used.

B. A record of this test shall be retained for the duration of the use of the dose calibrator.

C. Records shall include:

1. The model and serial number of the dose calibrator;

2. The configuration and calibrated activity of the source measured;

3. The activity of the source;

4. The activity measured and the instrument setting for each volume measured;

5. The date of the test; and

6. The signature of the Radiation Safety Officer.

D. Personnel shall mathematically correct dosage readings for any geometry or linearity error that exceeds ± 10 percent if the dosage is greater than 10 microcuries and shall repair or replace the dose calibrator if the accuracy or constancy error exceeds ± 10 percent.

E. Checks and tests must be completed following adjustment, relocation, or repair of the dose calibrator.

GAMMA CAMERAS

As a minimum, quality control procedures, frequencies and tolerance results/limits shall comply with those recommended by the equipment manufacturer prior to patient imaging. If not recommended by the manufacture these procedures will require Nuclear Medicine and Nuclear Cardiology personnel to perform flood checks on gamma cameras before each day of use and resolution checks on gamma cameras weekly with a bar phantom.

PET/CT

As a minimum, quality control procedures, frequencies and tolerance results/limits shall comply with those recommended by the equipment manufacturer prior to patient imaging.

RADIOPHARMACEUTICALS

Training

Nuclear Medicine/Nuclear Cardiology/PET or Radiation Safety Office personnel shall provide oral and/or written radiation safety instruction for all personnel caring for patients undergoing radiopharmaceutical therapy. Refresher training shall be provided at intervals not to exceed one (1) year.

A. The instruction shall describe:

1. Procedures for patient control;
2. Procedures for visitor control;
3. Procedures for contamination control;
4. Procedures for waste control;
5. Notification process of the Radiation Safety Office or authorized user in case of the patient's medical emergency or death; and
6. Training for workers as required by the “Regulations for Control of Radiation in Mississippi”.

B. The Radiation Safety Office shall keep a record of:

1. Personnel receiving instruction for radiopharmaceutical therapy;
2. A description of the instruction;
3. The date of the instruction; and
4. The name of the individual who provided the instruction and/or the method in which the instruction was delivered.

C. Radiopharmaceutical therapy training records shall be retained for inspection for three (3) years.

Safety Precautions

A. Each patient receiving radiopharmaceutical therapy will be provided a private room with a private bathroom.

B. The patient's room entrance will be posted with a "Caution Radioactive Materials" sign.

C. A radioactive precaution flag will be placed in the patient's chart in EPIC indicating the activity and isotope administered to the patient and duration of precautions.

D. Personnel will promptly after administration of the dosage, measure the dose rates in contiguous restricted and unrestricted areas with a radiation measurement survey instrument.

E. Records of these surveys shall be retained for three (3) years.

F. Survey records shall include:

1. The time and date of the survey;

2. A plan of the area or list of points surveyed;

3. The measured dose rate at several points expressed in millirems per hour (mR/hr);

4. The instrument used to make the survey; and

5. The initials of the individual who made the survey.

G. Trash and linen removed from the patient's room shall be monitored with a radiation detection survey instrument and held for decay-in-storage, when necessary, before being released.

H. Tray tables, blood pressure cuffs, pillows, and other items removed from the room must be surveyed before being released. If contaminated with radioactive material the items will be decontaminated before being released or held for decay-in-storage by the Radiation Safety Office.

I. A survey of the patient's room and bathroom for removable contamination will be made with a radiation detection survey instrument before assigning another patient to the room. The room must not be reassigned until removable contamination is less than 200 disintegrations per minute per 100 square centimeters.

J. A measurement of the thyroid burden of each individual who helped prepare or administer a dosage of iodine-131 will be made within 6-72 hours after administering the dosage.

K. Bioassay records will be retained for a period of three (3) years.

L. Bioassay records shall include:

1. The thyroid burden measurement;

2. Date of the measurement;

3. The name of the individual whose thyroid burden was measured; and

4. The initials of the individual who made the measurements.

Syringe Shields and Vial Shields

A. Nuclear Medicine/Nuclear Cardiology/PET personnel shall keep syringes that contain radioactive material to be administered in a radiation shield.

B. Personnel who prepare or administer radiopharmaceuticals shall use a syringe radiation shield unless the use of the shield is contraindicated for that patient.

C. Unless utilized immediately, personnel shall conspicuously label each syringe or syringe radiation shield that contains a syringe with a radiopharmaceutical, with the radiopharmaceutical name or its abbreviation, the type of diagnostic study or therapy procedure to be performed, or the patient's name.

D. Personnel preparing or handling a vial that contains a radiopharmaceutical shall keep the vial in a vial radiation shield.

E. Personnel shall conspicuously label each vial radiation shield that contains a vial of a radiopharmaceutical with the radiopharmaceutical name or its abbreviation.

Surveys Ambient Radiation Dose Rate

A. Nuclear Medicine/Nuclear Cardiology/PET personnel shall survey with a radiation detection survey instrument at the end of each day of use all areas where radiopharmaceuticals are routinely prepared for use or administered. This includes the hot lab, injection areas, holding rooms, camera rooms, and treadmill areas.

B. Nuclear Medicine/Nuclear Cardiology/PET personnel shall survey with a radiation detection survey instrument at least once each week all areas where radiopharmaceuticals or radioactive wastes are stored.

C. A survey instrument capable of measuring dose rates as low as 0.1 millirem per hour shall be used to make these surveys.

D. Survey instruments must have been calibrated within the last year.

E. The Radiation Safety Office and the Nuclear Medicine/Nuclear Cardiology/PET personnel for each department will establish the dose rate action levels for the restricted and unrestricted areas of each department.

    1. Nuclear Medicine/Nuclear Cardiology restricted area action level is 1.0 mR/hr and unrestricted area action level is 0.2 mR/hr.

    2. PET Imaging restricted area action level is 2.0 mR/hr and unrestricted area action level is 0.5 mR/hr.

F. Personnel performing area surveys shall immediately notify the Radiation Safety Office if a dose rate exceeds an action level.

Surveys for Contamination

A. Nuclear Medicine/Nuclear Cardiology/PET personnel shall survey for removable contamination each week of use all areas where radiopharmaceuticals are routinely prepared for use or administered and each week where radioactive materials are stored.

B. A survey instrument capable of detecting contamination on each wipe sample of 2000 disintegrations per minute (dpm) shall be used to perform wipe surveys.

    Calculations:

$$\frac{\text{Gross Sample CPM} - \text{Background CPM}}{\text{Instrument Counting Efficiency}} = \text{Net DPM}$$

C. The Radiation Safety Office and the Nuclear Medicine/Nuclear Cardiology/PET personnel for each department will establish restricted and unrestricted area removable contamination action levels.

   1. Nuclear Medicine/Nuclear Cardiology/PET restricted area action level is 2000 dpm/100 cm^2 and unrestricted area action level is 1000 dpm/100 cm^2.

D. Personnel performing wipe surveys shall immediately notify the Radiation Safety Office if contamination exceeds an action level.

E. Decontamination procedures will be followed if the action levels are exceeded.

Survey Records

Records of each survey must be retained for three (3) years. These records must include:

A. The date of the survey;

B. A sketch of each area surveyed;

C. Action levels established for each area;

D. The measured dose rate at several points in each area expressed in millirems per hour or the removable contamination in each area expressed in disintegrations per minute per 100 cm^2;

E. The serial number and the model number of the instrument used to make the survey or analyze the samples; and

F. The initials of the individual who performed the survey.

A drawing of the area surveyed keyed to and identifying relevant survey locations such as dose storage areas, source storage areas, injection areas, waste storage areas, sinks, L-block shields, treadmills, and gamma cameras shall be kept for each area using radioisotopes.

Storage of Volatiles and Gases

Nuclear Medicine/Nuclear Cardiology/PET personnel shall store volatile radiopharmaceuticals and radioactive gases in the shippers' radiation shield and container.

Personnel shall store and use a multi-dose container in a properly functioning fume hood.

Waste Decay In Storage

A. Nuclear Medicine/Nuclear Cardiology/PET personnel shall hold radioactive material for decay in storage before disposal in ordinary trash.

B. Radioactive waste shall be monitored at the container surface before disposal as ordinary trash to determine that its radioactivity cannot be distinguished from background

radiation levels. Surveys will be performed with a radiation detection survey instrument set on its most sensitive scale and with no interposed shielding.

C. All radiation labels shall be removed or obliterated before disposal in ordinary trash.

D. For radioactive material held for decay in storage a record of each disposal shall be retained for a period of three (3) years.

E. Disposal records must include:

1. The date of the disposal;

2. The date on which the radioactive material was placed in storage;

3. The radionuclides disposed of;

4. The model and serial number of the survey instrument used;

5. The background dose rate;

6. The radiation dose rate measured at the surface of each waste container; and

7. The name of the individual who performed the disposal survey and final disposal.

Disposal of Non-Decayed Waste

A. Unused doses and used syringes are returned in their shielded containers to the radiopharmacy for disposal.

B. Disposal of waste into the sanitary sewer system must comply with the monthly average concentration for the isotope listed in the "Regulations for Control of Radiation in Mississippi". The waste must be readily soluble or dispersible in water.

C. Records of sewer disposals shall include:

1. The date of the disposal;

2. The radionuclide; and

3. An estimated activity that was released (in millicuries or microcuries).

D. Excreta from patients undergoing medical diagnosis or therapy are exempt from all limitations listed in the Regulations.

Release of Therapy Patients Containing Radiopharmaceuticals

A. Personnel shall not authorize release from confinement for medical care any patient administered a radiopharmaceutical until the exposure rate from the patient has been taken and verification has been made that the total effective dose equivalent to any other individual from the patient's release is not likely to exceed 5 millisievert (0.5 rem). Nuclear Regulatory Commission NUREG-1556, Vol. 9, Appendix U, Table U.1. lists the

release activity for I-131 as 33 millicuries, the release exposure rate at 1 meter is listed as 7 millirem per hour.

B. Patients may be released with I-131 dose rates greater than 7 millirem per hour at 1 meter and activities greater than 33 millicuries in accordance with the guidelines for patient release in NRC Regulatory Guide 8.39 "Release of Patients Administered Radioactive Materials" and NUREG-1556, Vol. 9, Appendix U.

C. Records of releases of patients administered radiopharmaceuticals shall be retained for three (3) years.

Sealed Source Requirements

A. Nuclear Medicine/Nuclear Cardiology/PET departments are permitted to receive, possess, and use the following radioactive material for check, calibration, and reference use:

1. Sealed sources manufactured and distributed by persons specifically licensed by the U.S. Nuclear Regulatory Commission, Agreement State or Licensing State and that do not exceed 30 millicuries each.

2. Any radioactive material with a half-life of 120 days or less in individual amounts not to exceed 15 millicuries.

3. Any radioactive material with a half-life greater than 120 days in individual amounts not to exceed the smaller of 200 microcuries or 1000 times the quantities listed in Appendix B of Subchapter 3 in the “Regulations for Control of Radiation in Mississippi”.

4. Technetium-99m in individual amounts as needed.

B. Personnel in possession of a sealed source shall survey with a radiation survey instrument at intervals not to exceed three (3) months all areas where such sources are stored. Survey records shall be retained for three (3) years and shall include:

1. The date of the survey;

2. The measured dose rate in each area expressed in millirems per hour;

3. The model number and serial number of the survey instrument used to make the survey; and

4. The name of the person performing the survey.

C. Sealed sources must be tested for leakage. Nuclear Medicine/Nuclear Cardiology/PET departments in possession of a sealed source shall assure that:

1. The source is tested for leakage before its first use unless the department has a certificate from the supplier indicating that the source was tested within six (6) months before transfer to UMMC.

2. The source is tested for leakage at intervals not to exceed six (6) months or at intervals approved by the U.S. Nuclear Regulatory Commission in the Sealed Source and Device Registry, an Agreement State, or a Licensing State.

3. Leak tests shall be capable of detecting the presence of 0.005 microcuries of radioactive material on the test sample. The test samples are to be taken from the source or from the surfaces of the device in which the source is mounted or stored on which radioactive contamination might be expected to accumulate. These samples should be taken with the source in the off or shielded position.

4. Leak test records shall be retained for five (5) years. These records shall include:

    a. The model number and serial number, if assigned, of each source tested;

    b. The identity of each source radionuclide and its estimated activity;

    c. The measured activity of each test sample expressed in microcuries;

    d. A description of the method used to measure each test sample;

    e. The date of the test; and

    f. The signature of the Radiation Safety Officer.

5. If a leak test reveals the presence of 0.005 microcuries or more of removable contamination, personnel shall:

    a. Immediately withdraw the sealed source from use and store it in a shielded container;

    b. Seal the source/container in a plastic bag to prevent the spread of radioactive contamination; and

    c. Notify the Radiation Safety Office of the leaking source.

    d. The Radiation Safety Office will file a report with the MSDH/DRH within five (5) days of receiving the leak test results revealing the presence of 0.005 microcuries or more of removable contamination. The written report will include the model and serial number of the leaking source, if assigned; the radionuclide and its estimated activity; the results of the test the date of the test; and the action taken.

6. Leak tests are not required on the following sources:

    a. Sources containing only radioactive material with a half-life of less than 30 days;

    b. Sources containing 100 microcuries or less of beta or photon-emitting material or 10 microcuries or less of alpha-emitting material; and

c. Sealed sources, except teletherapy and brachytherapy sources, which are stored, not being used, and identified as in storage. However, leak tests are required for each such source before any use or transfer unless it has been tested for leakage within six (6) months before the date of use or transfer.

D. Nuclear Medicine/Nuclear Cardiology/PET departments in possession of a sealed source shall conduct a physical inventory of all such sources at intervals not to exceed three (3) months. These records shall be retained for three (3) years and shall include:

1. The model number and serial number of each source, if one has been assigned;

2. The identity of each source radionuclide and its nominal activity;

3. The location of each source;

4. The date of the inventory;

5. The name of the individual performing the inventory;

6. The signature of the Radiation Safety Officer; and

7. Nuclear Medicine/Nuclear Cardiology/PET personnel shall annotate on the inventory any sealed source that is in storage and not being leak tested.

E. Nuclear Medicine/Nuclear Cardiology/PET personnel shall contact the Radiation Safety Office before purchasing and shipping radioactive sources.

1. Verification must be made that sealed sources being returned to the manufacturer for disposal has had a leak test performed within the last six (6) months.

2. Every effort will be made to have the manufacturer agree to dispose of old sources when purchasing new check sources. This will help lower disposal costs for radioactive sources.

F. Nuclear Medicine/Nuclear Cardiology/PET personnel must contact the Radiation Safety Office before transport of radioactive material and sealed sources between the Jackson Medical Mall and the UMMC campus to assure that Department of Transportation Regulations are followed.

HIGH DOSE RATE AFTERLOADER

Facility

A. A remote video system permitting continuous observation of the patient from outside the HDR afterloader treatment room during patient treatment is required.

B. An intercom system between the treatment room and the operating console is required.

C. A door at each entrance shall control access to the room housing the HDR afterloader. Such doors shall normally be closed.

D. Each door to the room housing the HDR afterloader will be posted with a "Caution: Radioactive Materials" and "Caution, High Radiation Area" sign.

E. If the HDR afterloader unit is housed in a treatment room with an accelerator or other source of radiation, controls will be in place so that only one source of irradiation can be utilized at any one time.

F. Radiation Oncology personnel shall secure the unit, the console, the console keys, and the treatment room when not in use or unattended.

G. The entrance to the irradiation room shall be equipped with an electrical interlock system that will cause the source to return to the shielded position immediately upon opening of the entrance door. The interlock system shall be connected in such a manner that the source cannot be placed in the irradiation position until the entrance door is closed and the source “on-off” control is reset at the control panel.

H. The electrical interlocks on the entrance to the irradiation room shall be tested for proper operation at least once each day of use.

I. Records of interlock tests shall be retained for inspection by the MSDH/DRH for three (3) years.

J. In the event of a malfunction of the door interlock, the HDR afterloader shall be locked in the “off” position and not used, except as is necessary for repair or replacement of the interlock system, until the interlock system is shown to be functioning properly.

K. The irradiation room shall be equipped with a radiation monitoring device which continuously monitors the radiation level and is equipped with a back-up battery power supply for emergency operation. This device shall energize a visible signal to make the operator continuously aware of the radiation level in order that appropriate emergency procedures can be instituted to prevent unnecessary radiation exposure. This monitor shall be tested for proper operation at the beginning of each day of use.

L. Whenever the continuous radiation monitoring device is not operational, any person entering the room following an irradiation shall enter with an operable, calibrated radiation survey meter or audible alarming personal dosimeter to monitor for any malfunction of the source exposure mechanism. The instrument or dosimeter shall be checked with a dedicated check source for proper operation at the beginning of each day of use.

M. Prompt repair or replacement of the radiation monitor shall be required if it is inoperable.

N. A record of the radiation monitor or instrument checks shall be retained for three (3) years. The record shall include:

1. The date of the check;

2. Notation that the monitor indicates when the source is exposed; and

3. The initials of the individual who performed the check.

Maintenance

A. Installation and replacement of the sealed source contained in the HDR afterloader shall only be performed by the manufacturer's representatives.

B. Only the manufacturer's representatives shall perform maintenance or repair on the HDR afterloader involving work on the source safe, the source drive unit, or other mechanism that could expose the source, reduce the shielding around the source, or compromise the safety of the unit and result in increased radiation levels.

Surveys

A. Prior to initiation of a treatment program using the HDR afterloader and subsequent to each source exchange a radiation survey shall be made of:

1. The HDR afterloader housing with the source in the shielded position. The maximum radiation levels at 10 centimeters (4 inches) from the nearest accessible surface of the main source safe shall not exceed 1 milliroentgen per hour.

2. All areas adjacent to the treatment room with the source in the "irradiation" position. This area survey shall clearly establish that radiation levels in restricted areas are not likely to cause personnel exposure in excess of the limits for adult occupational workers or in unrestricted areas the limits for members of the public.

B. Records of the above surveys shall be retained for three (3) years.

Leak Test

A. The sealed source (Ir-192) is tested for leakage before it is shipped from the manufacturer.

B. The Medical Physicist will keep the sealed source certificate containing the leak test information on file in Radiation Oncology.

C. The Medical Physicist or Radiation Safety Office shall verify that the source was tested within the previous six (6) months before shipment of the source back to the manufacturer for disposal.

D. The leak test records shall be retained for five (5) years.

Inventories

A. Radiation Oncology shall conduct a physical inventory of all sealed sources installed in the HDR afterloader and awaiting installation or shipment for disposal at intervals not to exceed three (3) months.

B. The inventory records shall contain:

1. The model number of each source;

2. Serial number of the source if one has been assigned;

3. The identity of each source radionuclide and its nominal activity;

4. The location of each source;

5. Date of the inventory; and

6. The signature of the Radiation Safety Officer.

C. The Medical Physicist shall annotate on the inventory any sealed source that is in storage and not being leak tested.

D. Inventory records shall be retained for three (3) years.

Quarterly Surveys

A. The Medical Physicist shall survey with a radiation survey instrument all areas where sealed sources are stored at intervals not to exceed three (3) months.

B. The record shall include:

1. The date of the survey;

2. A sketch of each area that was surveyed;

3. The measured dose rate at several points in each area expressed in millirems per hour;

4. The model number and serial number of the survey instrument used to make the survey; and

5. The name of the individual performing the survey.

C. Survey records shall be retained for three (3) years.

Patient Surveys

A. At the conclusion of each HDR afterloader procedure and after retracting the source from the patient into its shielded position in the HDR afterloader unit, a radiation survey shall be made immediately of the patient, the HDR afterloader, and the area of use. A portable radiation detection survey instrument will be used to confirm that the source has been removed from the patient and has returned to the safe, shielded position.

B. Records of the survey must include:

1. Manufacturer, model number, and serial number of the survey instrument used;

2. dose rate expressed as mR/hr;

3. Time and date of the survey; and

4. The name of the individual making the survey.

C. Records of surveys shall be maintained for three (3) years.

Dosimetry Equipment

A. Radiation Oncology shall have a calibrated dosimetry system available for calibration of the HDR afterloader source. To satisfy this requirement, one of the following two conditions shall be met:

1. The system shall have been calibrated using a system or source traceable to the National Institute of Standards and Technology or by a calibration laboratory accredited by the American Association of Physicists in Medicine. The calibration shall have been performed within the previous 2 years and after any servicing that may have affected system calibration; or

2. The system shall have been calibrated within the previous 4 years. From 18 to 30 months after that calibration, the system shall have been inter-compared with another dosimetry system that was calibrated within the past 24 months by the National Institute of Standards and Technology or by a calibration laboratory accredited by the American Association of Physicists in Medicine. The inter-comparison meeting shall be sanctioned by a calibration laboratory or radiologic physics center accredited by the American Association of Physicists in Medicine. The results of the inter-comparison meeting must have indicated that the calibration factor of the system had not changed by more than 2 percent. The inter-comparison result shall not be used to change the calibration factor.

B. Radiation Oncology shall maintain a record of each calibration, inter-comparison, and comparison for the duration of the license. For each calibration, inter-comparison, or comparison, the record shall include:

1. The date;

2. The manufactures name, model numbers and serial numbers of the instruments that were calibrated, inter-compared, or comparison;

3. The correction factors that were determined;

4. The names of the individuals who performed the calibration, inter-comparison, or comparison; and

5. Evidence that the inter-comparison meeting was sanctioned by a calibration laboratory or radiologic physics center accredited by the American Association of Physicists in Medicine.

Calibration

A. The Authorized User or Authorized Medical Physicist shall perform the calibration and checks on the HDR afterloader before the first medical use of the unit following replacement of the source or reinstallation of the unit in a new location outside the facility; following any repair of the unit that includes the removal of the source or major repair of the components associated with the source exposure assembly; and at intervals not to exceed one (1) quarter.

B. Each new source installed into the HDR afterloader shall be verified with a calibrated well chamber before the unit is used for patient treatment. The difference between the calculated activity and the measured activity must be within ± 5 percent.

C. A source positioning check will be performed to ensure that the accuracy of source positioning in the catheter guide tube is accurate to within ± 1 millimeter to the programmed position. A film can be used to verify the accuracy of the source positions.

D. The timer accuracy and linearity over the typical range of use will be checked after each new source installation.

E. A test of the source retraction utilizing the backup battery system when power to the unit is removed will be performed.

F. The length of the source transfer tubes will be checked.

G. The length of the applicators will be measured.

H. Check the functions of the source transfer tubes, applicators, and the transfer tube-applicator interfaces.

I. Calibration records will include:

1. The date of the calibration;

2. The manufacturer's name;

3. Model number and serial number of the HDR unit;

4. The isotope, activity, and serial number of the sealed source;

5. The model and serial number of the well chamber and electrometer used for the calibration;

6. The results of the calibration; and

7. The signature of the Authorized Medical Physicist who performed the calibration.

J. A record of the HDR afterloader calibration shall be maintained for three (3) years.

Daily Spot Checks

A. At the beginning of each day of use and after each source installation the following checks will be performed:

1. The function of electrical interlocks at each HDR afterloader unit room entrance.

2. The source exposure indicator lights on the remote afterloader unit, on the control console, and in the facility.

3. Viewing and intercom systems shall be checked.

4. Emergency response equipment will be inventoried.

5. Radiation monitors will be checked for proper operation.

6. Timer accuracy will be checked.

7. The date and time will be checked in the unit's computer.

8. The sources' decayed activity will be checked in the unit's computer.

B. If the results of the above checks indicate a malfunction of any system, Radiation Oncology personnel shall lock the HDR afterloader control console in the “off” position and not use the unit except as is necessary to repair, replace or check the malfunctioning system.

Spot check records shall include:

1. The date;

2. The manufacturer's name, model number, and serial number for the HDR afterloader unit and source;

3. An assessment of timer accuracy;

4. Notations indicating the operability of each entrance door electrical interlock;

5. Operability of radiation monitors, source exposure indicator lights, viewing and intercom systems, and clock;

6. Decayed source activity in the unit's computer; and

7. The name of the individual who performed the spot check and the signature of the Authorized Medical Physicist who reviewed the record of the spot-check.

C. A record of the daily spot checks shall be retained for three (3) years.

Emergency Procedures

The emergency source recovery equipment is located adjacent to HDR unit and consists of remote handling tools (forceps), shielded storage container (Pig), and a cable cutter. This equipment will be located and checked before each HDR afterloader treatment.

A set of written emergency instructions shall be posted at the HDR afterloader operator console. These instructions shall inform the operator of the procedures to be followed if the source fails to return to the shielded position.

See emergency procedures

Training

Training on the HDR afterloader will be performed before initiation of treatment and annually thereafter. This training will include:

A. key controls

B. console operations

C. catheters and applicators

D. video and intercom systems

E. door interlocks

F. radiation monitors

G. survey meter usage

H. battery backup systems

I. drills of the emergency procedures

J. emergency equipment

K. emergency contacts

Plan and Administration of Treatment

A. A plan of treatment is made for each patient.

B. A separate individual from the individual who performed the calculations checks each plan for accuracy and compliance with the written directive of the Radiation Oncologist.

C. The separate check shall verify that each treatment is in accordance with the written directive of the Radiation Oncologist and shall be done by the Medical Physicist, Dosimetrist, or a Radiation Therapist.

D. Any deviation from the written directive is identified and appropriate action for correction is taken immediately.

E. A chart review is done weekly to verify plans, doses and deviations.

F. Documentation of each check, dose administration, deviation and action is made in the patient Radiotherapy Medical Record.

G. The patient's Radiotherapy Medical Record shall be retained at least five (5) years.

Procedures

A. A written directive by an Authorized User approved by the Radiation Safety Committee is required for treatments utilizing the HDR afterloader.

B. The Authorized User and the Authorized Medical Physicist must be physically present during the initiation of all patient treatments involving the HDR afterloader.

C. An Authorized Medical Physicist and either an Authorized User or a physician, under the supervision of an Authorized User, who has been trained in the operation and emergency

response for the unit is required to be physically present during continuation of all patient treatments involving the unit.

D. Only the patient is allowed in the treatment room during the afterloader use.

E. Radiation Oncology personnel shall notify the Radiation Safety Office and the Authorized User immediately if the patient has a medical emergency or dies.

MANUAL BRACHYTHERAPY

Facility

A. Patients being treated with temporary manual brachytherapy sources will be treated in a private room with a private bathroom.

B. This room shall be placed as far away from the nursing station and heavy traffic hallways as possible, and may be lined with lead to reduce exposure.

C. If the sources are present, the patient's room will be posted "Caution Radioactive Materials".

D. A survey will be performed on the patient with the sources in place to see if additional postings such as "Caution Radiation Area" are required.

E. Posting requirements will remain in effect until all sources have been removed from the room and a survey has been performed on the patient and the room.

Patient Surveys

A. The patient will be surveyed by the Medical Physicist or Radiation Safety Office to ensure a baseline radiation level prior to administration of the brachytherapy treatment. Be aware that a nuclear medicine study may have been performed prior to treatment.

B. Immediately after implanting sources in a patient, the Medical Physicist or Radiation Safety Office shall make a radiation survey of the patient. The results of this survey shall be posted outside the patient's room on the form "Nursing Instructions for Patients Treated with Brachytherapy Sources". Exposure rate measurements will be taken at the patient's bedside, one meter from the patient and at the entrance to the room.

C. Promptly after implanting the sources, the Medical Physicist or Radiation Safety Office will survey the exposure rates in contiguous restricted and unrestricted areas with a radiation measurement survey instrument to demonstrate compliance with the regulations for personnel exposure within the limits for adult occupational workers or in unrestricted areas the limits for members of the public.

D. A record of each patient survey will be maintained for three (3) years. The record will include:

1. The time and date of the survey;

2. A sketch of the area or list of points surveyed;

3. The measured dose rate at several points expressed in milliroentgen (mR) per hour;

4. The instrument used to make the survey; and

5. The initials of the individual who made the survey.

E. Immediately after removing the last temporary implant source from a patient, the Medical Physicist or Radiation Safety Office shall perform a radiation survey of the patient with a radiation detection survey instrument to confirm that all sources have been removed.

F. Radiation Oncology shall maintain a record of patient surveys for three (3) years. Each record shall include:

1. The date of the survey;

2. The name of the patient;

3. The exposure rate from the patient expressed as milliroentgens (mR) per hour measured on contact and at 1 meter from the patient;

4. The survey instrument used; and

5. The initials of the individual who made the survey.

G. The Medical Physicist or Radiation Safety Office shall make a radiation survey of the patient's room to confirm that no sources have been misplaced.

H. A patient treated by temporary implant shall not be released from confinement for medical care until all sources have been removed and surveys have been completed.

Quarterly Surveys of Storage Areas

A. Radiation Oncology shall survey all areas where manual brachytherapy sources are stored with a radiation survey instrument at intervals not to exceed three (3) months. The record shall include:

1. The date of the survey;

2. A sketch of each area that was surveyed;

3. The measured exposure rate at several points in each area expressed in milliroentgens (mR) per hour;

4. The model number and serial number of the survey instrument used to make the survey; and

5. The name or the individual performing the survey.

B. Radiation Oncology shall retain a record of each storage area survey for three (3) years.

Inventories

A. Patient Administration - Radiation Oncology shall make a record of brachytherapy source utilization, which includes, prior to implant insertion information:

1. The names of the individuals permitted to handle the sources;
2. The number and activity of sources removed from storage;
3. The patient's name;
4. The room number of use;
5. The time and date they were removed from storage;
6. The number and activity of sources in storage after the removal; and
7. The initials of the individual who removed the sources from storage;

AND promptly after removing the brachytherapy sources from a patient, the Medical Physicist shall return the sources to the secured storage area and record:

8. The number and activity of sources returned to storage;
9. The patient's name;
10. The room number of use;
11. The time and date they were returned to storage;
12. The number and activity of sources in storage after the return; and
13. The initials of the individual who returned the sources to storage.
14. If any discrepancies exist between the inventory record and the number of sources in use and in storage, the Radiation Safety Office shall be notified immediately.
15. Radiation Oncology shall maintain the inventory records for three (3) years.

B. Quarterly inventories - Radiation Oncology shall conduct a physical inventory of all brachytherapy sources at intervals not to exceed three (3) months. The inventory records shall contain:

1. The model number of each source;
2. Serial number, if one has been assigned;
3. The identity of each source radionuclide and its estimated activity;
4. The location of each source;
5. Date of the inventory; and

6. The signature of the Radiation Safety Officer.

7. Radiation Oncology shall retain each inventory record for three (3) years.

8. The Medical Physicist shall annotate on the inventory any sealed source that is in storage and not being leak tested.

C. Accountability - Brachytherapy sources shall be stored in a secure storage area. Radiation Oncology shall maintain accountability for all brachytherapy sources at all times whether in storage or use.

Leak Test

A. Leak tests shall be performed on all brachytherapy sources before any medical use or transfer unless the sources have been tested for leakage within six (6) months before the date of use or transfer.

B. Leak tests shall be performed on all sealed brachytherapy sources at intervals not to exceed six (6) months.

C. The leak test records shall contain:

1. The model number;

2. The serial number, if assigned, of each source tested;

3. The identity of each source radionuclide and its estimated activity;

4. The measured activity of each test sample expressed in microcuries;

5. The date of the test;

6. The equipment used to count the sample; and

7. The signature of the Radiation Safety Officer.

D. Leak test records will be retained for five (5) years.

Calibration

A. Prior to the first medical use of a brachytherapy sealed source, the Medical Physicist shall determine the source activity using a calibrated well chamber and determine the source positioning accuracy within applicators.

1. The Medical Physicist may use measurements provided by the source manufacturer.

2. The Medical Physicist shall mathematically correct the activity of the source for physical decay at intervals consistent with 1.0% physical decay. (i.e. 159.68 days for Cs-137)

3. An Authorized Medical Physicist shall perform or review the calculation measurements.

B. Radiation Oncology will retain a record of the calibrations on each brachytherapy source for three (3) years after the last use of the source. The record must include:

1. The date of the calibration;
2. The source manufacturer's name;
3. Model number;
4. Serial number for the source;
5. Instruments used to calibrate the source;
6. The source activity;
7. Source position accuracy within applicators; and
8. The signature of the Authorized Medical Physicist.

Training

A. Brief nursing personnel on radiation safety precautions. Use the sample form, "Nursing Instructions for Patients Treated with Brachytherapy Sources," as an outline. Allow time for questions and answers during the briefing.

B. Radiation safety training will be provided to personnel caring for patients undergoing manual brachytherapy. The training will include information on:

1. The size and shape of the brachytherapy sources;
2. Safe handling and shielding instructions;
3. Patient control;
4. Visitor control; and
5. Emergency contacts.

This training will be provided initially before treatments begin and at least annually thereafter.

Note: a vendor or UMMC personnel will provide this training.

C. Training records will be retained for three (3) years. The records must include:

1. A list of the topics covered;
2. The date of the training;
3. The names of the attendees; and
4. The name of the person providing the training.

Procedures

A. A written directive by an Authorized User approved by the Radiation Safety Committee is required for treatments utilizing sealed sources for brachytherapy.

B. The Authorized User and the Medical Physicist must be physically present during the initiation of all patient treatments involving manual brachytherapy sources.

C. Only those persons needed for medical, safety, or training purposes shall be present during the implant procedure.

D. Brief the patient on radiation safety procedures for confinement to bed, visitor control, and other items as applicable consistent with good medical care. Patients shall not leave the room during the treatment period.

E. Supply the nurses caring for brachytherapy patients with radiation monitoring badges, pocket ionization chambers or an electronic alarming dosimeter and instruct them in the use of these monitoring devices. Extremity dosimetry may also be supplied to nurses who must provide extended personal care to the patient.

F. Any individual who handles the sources must wear extremity monitoring in addition to a whole body badge.

G. Access will be limited for housekeeping and dietary personnel. All bed linens must be checked with a radiation detection survey meter before being removed from the room to ensure that no dislodged sources are inadvertently removed from the room.

H. Visitors will not be allowed inside the treatment room except on a case by case basis and prior instruction and approval of the Radiation Safety Office while sources are implanted. Visitors will be instructed to maintain a safe distance from the patient.

I. No one under the age of 18 will be allowed to enter the patient's room while the sources are implanted.

J. Brachytherapy sources will be transported in a shielded container between their storage location and the treatment room.

Emergency Procedures

A. Emergency equipment consisting of remote handling tools (forceps) and a shielded storage container (Pig) will be located in the far corner of the room during the brachytherapy treatment.

B. Never touch needles, capsules, or containers holding brachytherapy sources.

C. If a source becomes inadvertently dislodged from the patient or inadvertently lodged within the patient following removal of the source applicators, use long forceps to grab the source and place it in the shielded container in the corner of the room.

D. If a source becomes dislodged, immediately contact Radiation Oncology at 984-2550 and the Radiation Safety Office at 601-984-1980. After hours and weekends see online On-Call schedule or contact Emergency Dispatch at 601-984-1420.

E. Note the time the source was found dislodged and the location of the source from the patient when found.

F. Personnel shall notify the Radiation Safety Office and Authorized User immediately if the patient has a medical emergency or dies.

PERMANENT IMPLANT SEEDS

Release Requirements

A. Radiation Oncology shall not release a patient with a permanent implant until the measured dose rate from the patient has been taken and is shown to be such that the total effective dose equivalent to any other individual from exposure to the released individual is not likely to exceed 5 millisievert (0.5 rem). If the dose rate for a permanent implant patient is higher than allowed, the authorized user, authorized medical physicist and radiation safety office will determine an appropriate course of action.

B. Records of releases of patients with permanent implants shall be retained for three (3) years.

C. If a patient is authorized for release, they will be provided with radiation safety guidance on how to maintain doses to other individuals, such as family members and members of the public, as low as reasonably achievable. This guidance must include:

1. The need to maintain distance from other individuals, including sleeping arrangements and avoiding public transportation and public places;

2. Avoiding close contact with children and expectant mothers;

3. The length of time precautions are necessary; and

4. Actions to be followed upon the discovery of a dislodged source including notification of Radiation Oncology or the Radiation Safety Office.

D. Radiation Oncology shall maintain a record of source accountability for permanent implants, which shall include:

1. The number and activity of sources removed from storage, the date they were removed from storage, and the name of the individual who removed them from storage;

2. The number and activity of sources returned to storage, the date they were returned to storage, and the name of the individual who returned them to storage; and

3. The number and activity of sources permanently implanted in the patient.

E. Radiation Oncology shall retain a record of permanent implants for three (3) years.

F. Permanent implant seeds will be stored in their manufacturer's shipping container inside a secure storage area.

G. Sources will be entered on the inventory log upon receipt, and source information to include the isotope, activity, and number of seeds will be verified against the shipping label.

THERAPEUTIC RADIATION SYSTEMS

A. Written safety procedures and rules shall be developed by an Authorized Medical Physicist and shall be provided to each individual operating a therapeutic radiation machine, including any restrictions of the operating technique required for the safe operation of the particular therapeutic radiation machine.

B. Individuals shall not be exposed to the useful beam except for medical therapy purposes and unless such exposure has been ordered in writing by a licensed practitioner of the healing arts who is specifically identified on the Certificate of Registration. This provision specifically prohibits deliberate exposure of an individual for training, demonstration or other non-healing-arts purposes.

C. All individuals associated with the operation of a therapeutic radiation machine shall be instructed in and shall comply with the provisions of the Quality Management Program.

D. Provision shall be made to permit continuous observation of the patient during irradiation and shall be so located that the operator can observe the patient from the control panel. The therapeutic radiation machine shall not be used for patient irradiation unless at least one viewing system is operational.

E. Provision shall be made for continuous two-way aural communication between the patient and the operator at the control panel.

F. Persons other than the patient shall not be present in the treatment room when radiation of energy greater than 150 keV is being used. At operating potentials of 150 kV or below, other persons may be in the treatment room for good reason but only if they are provided with leaded aprons, leaded gloves and/or portable shields and their surface air kerma dose is monitored.

G. If the x-ray tube of a contact therapy unit is hand held during irradiation, the user shall wear protective gloves and apron. A cap of at least 0.5-mm lead equivalent should cover the aperture window of the tube housing of such apparatus when the apparatus is not being used.

Comment: Because the kerma rate in air at the beam output surface of contact therapy and beryllium window machines may be more than 100 Gy/min (10,000 rad/min), extreme precautions are necessary to prevent accidental exposure to the beam.

H. A qualified expert shall calibrate all therapeutic radiation machines before being used for the treatment of patients.

I. Therapeutic radiation equipment and installations shall be subjected to a complete radiation protection survey by a qualified expert prior to use on patients to establish radiation safety status of the installation.

J. Interlocks shall be provided such that all entrance doors, including doors to any interior booths, shall be closed before treatment can be initiated or continued. If any door opening interrupts the radiation beam, it shall not be possible to restore the machine to operation without closing the door and reinitiating irradiation by manual action at the control panel.

K. Periodic quality assurance checks shall be performed on therapeutic radiation machines in accordance with procedures established by the Authorized Medical Physicist.

L. Appropriate survey and quality assurance testing instrumentation shall be available within the department. Such equipment shall be maintained and calibrated as required by the regulations.

ELECTRONIC BRACHYTHERAPY

Facility

Each location where electronic brachytherapy is performed shall be provided with such primary and/or secondary barriers as are necessary to ensure compliance with ALARA principles. Shielding plans will be required to determine the necessity of such barriers. In addition to the requirement for primary and/or secondary barriers, the following design requirements are made:

A. Each treatment room shall have provisions to permit continuous aural communication and visual observation of the patient from the treatment control panel during irradiation. The electronic brachytherapy unit shall not be used for patient irradiation unless the patient can be observed.

B. If applicable, provision shall be made to prevent simultaneous operation of more than one radiation-producing therapeutic device in a treatment room.

C. For electronic brachytherapy units operated at accelerating potentials lower than 60 kV:

1. Access to the treatment room shall be controlled by a door at each entrance.

2. Radiation shielding for the staff in the treatment room shall be available, either as a portable shield and/or as localized shielded material around the treatment site. The shielding shall be designed (in terms of width, height, thickness and distance from the source) to limit the radiation exposure to all personnel within permissible limits.

Electrical Safety:

A. The high voltage transformer shall be electrically isolated to prevent electrical and magnetic interference with the surrounding environment and ancillary equipment.

B. The high voltage transformer shall be isolated from personnel (e.g., operator) and the environment by protective housing that can only be accessed through a cover requiring a tool for access or with electrical interlocks to prevent operation while open.

C. The high voltage transformer shall have appropriate safety labels warning personnel of potential electrical shock and/or heat related injuries.

D. All electrical equipment shall follow Medical Electrical Equipment Standards or their revisions, where appropriate, particularly:

1. IEC 60601-1:1998+A1+A2:1995 Medical Electrical Equipment - Part 1: General Requirements for Safety
2. IEC 60601-1-2:2001 Medical Electrical Equipment. General Requirements for Safety. Collateral Standard. Electromagnetic Compatibility. Requirements and tests
3. IEC 60601-2-8:1999 Medical Electrical Equipment - Part 2-8: Particular requirements for the safety of therapeutic x-ray equipment operating in the range from 10 kV to 1MV
4. IEC 60601-2-17:2004 Medical Electrical Equipment - Part 2-17: Particular requirements for the safety of automatically-controlled brachytherapy afterloading equipment

Treatment-unit Requirements

A. The control panel shall provide:

1. An indication of whether electrical power is available at the control panel and if activation of the x-ray tube is possible;

2. An indication of whether x-rays are being produced;

3. A means for indicating x-ray tube potential and current; and

4. The means for terminating an exposure at any time.

B. A suitable irradiation-control device shall be provided to terminate the irradiation after a pre-set time interval or integrated charge on a dosimeter-based monitor.

1. A dwell-duration display/timer or integrator shall be provided at the treatment control panel. The dwell-duration display/timer or integrator shall indicate planed setting as well as the time or signal elapsed or remaining.

2. The dwell-duration display/timer or integrator shall be a cumulative device that activates with an indication of the treatment delivery (“beam in use”) and retains its reading after irradiation is interrupted or terminated.

3. The dwell-duration display/timer or integrator shall terminate irradiation when a pre-selected time or integrated signal has elapsed, if any dose monitoring system present has not previously terminated irradiation.

4. The dwell-duration display/timer or integrator shall permit setting of exposure times as short as 0.1 second.

5. The dwell-duration display/timer shall not permit an exposure if set at zero.

6. The dwell-duration display/timer shall be accurate to within 1 percent of the selected value or 0.1 second, whichever is greater.

Authorized Medical Physicist Support

The Authorized Medical Physicist shall be responsible for:

A. Evaluation of the output from the electronic brachytherapy source;

B. Generation of the necessary dosimetric information;

C. Supervision and review of treatment calculations prior to initial treatment of any treatment site;

D. Establishing the quality assurance spot checks and reviewing the data from those checks as required;

E. Consultation with the authorized user in treatment planning, as needed; and

F. Perform calculations/assessments regarding patient treatments that may constitute medical events.

Operating Procedures

A. Only individuals approved by the Authorized User, Radiation Safety Officer, or Authorized Medical Physicist shall be present in the treatment room during treatment.

B. Protective shielding barriers shall be available for persons in the treatment room when the beam is energized. Personnel unable to remain behind the shielding should wear fluoroscopic aprons and thyroid shields when compatible with patient safety and necessary for the radiation exposure levels possibly encountered.

C. The Authorized Medical Physicist will determine which persons in the treatment room require monitoring when the beam is energized.

D. When the unit and/or shielding is portable, the operator shall use a survey meter to verify proper placement of the shielding immediately upon initiation of treatment, or alternatively the Authorized Medical Physicist may define areas within the room and appropriate shield locations necessary to maintain safe radiation levels to the operator.

E. An Authorized Medical Physicist shall be physically present from the initiation through the duration of all patient treatments involving the unit.

F. During operation, the operator shall monitor the position of all persons in the treatment room, and all persons entering the treatment room, to prevent entering persons from unshielded exposure from the treatment beam.

G. The electronic brachytherapy unit shall be inoperable, either by hardware or password, when unattended by qualified staff or service personnel.

H. A copy of the current operating and emergency procedures shall be physically located at the electronic brachytherapy unit control console;

I. Written procedures shall be developed, implemented, and maintained for responding to an abnormal situation. These procedures shall include:

1. Instructions for responding to equipment failures and the names of the individuals responsible for implementing corrective actions; and

2. The names and telephone numbers of Authorized Users, Authorized Medical Physicists, and the Radiation Safety Officer, to be contacted if the unit or console operates abnormally.

J. If a patient must be held in position during treatment, mechanical supporting or restraining devices shall be used;

K. The Radiation Safety Office and an Authorized User shall be notified as soon as possible if the patient has a medical emergency, suffers injury or dies. The Radiation Safety Office or the Authorized Medical Physicist shall inform the manufacturer of the event.

X-ray Source Calibration Measurements

A. Validation of the electronic brachytherapy x-ray source output shall be performed by, or under the personal supervision of, an Authorized Medical Physicist.

B. Calibration validation measurements shall be made for each x-ray tube, or after any repair affecting the x-ray beam generation, or when indicated by the spot checks.

C. Calibration validation must include, as applicable, determination of:

1. The output within 2 % of the expected value, if applicable, or determination of the output if there is no expected value;

2. Timer accuracy and linearity over the typical range of use;

3. Proper operation of back-up exposure control devices;

4. Evaluation that the relative dose distribution about the source is within 5 % of that expected; and

5. Source positioning accuracy to within 1 millimeter within the applicator.

D. The validation of the output shall be completed with a calibrated dosimetry system that has been calibrated by the National Institute for Standards and Technology (NIST) or by an American Association of Physicists in Medicine (AAPM) Accredited Dosimetry Calibration Laboratory (ADCL). The calibration shall have been performed within the previous 24 months and after any servicing that may have affected system calibration.

E. Required calibration measurements shall be completed in accordance with any current recommendations from a recognized, national professional association (such as the American Association of Physicists in Medicine) for electronic brachytherapy when available. Equivalent alternative methods are acceptable. In the absence of a protocol by a national professional association, published protocol included in the device manufacturer's operator's manual should be followed.

Routine and Day-of-Use Periodic Spot checks for Electronic Brachytherapy Units

A. A program to perform spot checks of each electronic brachytherapy facility and on each unit is required:

1. At the beginning of each day of use of an electronic brachytherapy unit;

2. Each time the unit is moved to a new room or site; and

3. After each x-ray tube installation.

B. The Authorized Medical Physicist will establish written procedures for performing the spot checks.

1. The Authorized Medical Physicist need not personally perform the spot check measurements, but maintains the responsibility for general supervision of the spot checks.

2. If performed by someone else, the Authorized Medical Physicist will review the results of each spot check within 2 days.

3. A record of the results of the spot check shall be retained for three (3) years.

4. The Authorized Medical Physicist shall notify the Authorized User as soon as possible in writing of any failures detected during the spot checks.

C. If the results of the checks indicate the malfunction of any system, clinical use of the system shall be halted until repair.

D. A record of each check shall be retained for three (3) years.

E. Spot checks of safety devices must, at a minimum, assure proper operation of:

1. Radiation exposure indicator lights on the electronic brachytherapy unit and on the control console;

2. Viewing and intercom systems in each electronic brachytherapy facility, if applicable;

3. Radiation monitors, if applicable; and

4. The integrity of all cables, catheters or parts of the device that carry high voltages.

F. Spot checks of dosimetry must include:

1. Checks that the output of the x-ray source falls within 3 % of expected values, which might include, as appropriate for the unit:

2. Output as a function of time, or

3. Output as a function of setting on a monitor chamber;

4. Verification of the consistency of the dose distribution to within 3% of that found during calibration;

5. Validation of the operation of positioning methods to assure that the treatment dose exposes the intended location within 1 mm; and

6. Inspection of all treatment components (e.g., connecting guide tubes, transfer tubes, transfer-tube-applicator interfaces, treatment spacers) on the day of use for any imperfections.

Records

A record of each check shall be retained for three (3) years. The record shall include:

A. The date of the check;

B. The manufacturer's name, model number, and serial number of the electronic brachytherapy unit;

C. Notations indicating the operability of radiation monitors, source exposure indicator lights, viewing and intercom system, applicators, source-transfer tubes, and transfer tube-applicator interfaces, and source-positioning accuracy, as applicable ; and

D. The name and signature of the individual who performed the check.

Treatment Planning

A. Where applicable, the Authorized Medical Physicist shall perform acceptance testing on the treatment planning system of therapy-related computer systems in accordance with published protocols accepted by nationally recognized bodies. At a minimum, the acceptance testing shall include, as applicable, verification of:

1. The source-specific input parameters required by the dose-calculation algorithm;

2. The accuracy of dose, dwell-time (if applicable), and treatment-time calculations at representative points;

3. The accuracy of isodose plots and graphic displays;

4. The accuracy of the software used to determine source positions from images; and

5. If the treatment-planning system is different from the treatment-delivery system, the accuracy of electronic transfer of the treatment-delivery parameters to the treatment-delivery unit from the treatment-planning system.

B. The position indicators in the applicator shall be compared to the actual position of the source or planned dwell positions as appropriate at the time of commissioning.

C. Prior to each patient treatment regimen, the parameters for the treatment shall be evaluated and approved by the Authorized User and the Authorized Medical Physicist for correctness through means independent of that used for the determination of the parameters.

Training

A. Instruction shall be provided initially to all individuals who operate the unit, as appropriate to the individual's assigned duties, in operating the unit. If the interval between patients exceeds one year, retraining of the individuals shall be provided.

B. The Authorized Users and Authorized Medical Physicists shall receive device specific instruction from the manufacturer, initially, and from trained persons annually.

C. The training shall be specific for the treatment unit, and of a duration as recommended by a national professional society (e.g., the American Association of Physicists in Medicine) if applicable, otherwise as specified by the device manufacturer, and shall include, but nor be limited to:

1. Unit-specific radiation safety requirements;

2. Unit operation; and

3. Emergency procedures, including an emergency drill.

D. Records of individuals receiving instruction required by this section shall be retained for three (3) years. The record shall include a list of the topics covered, the date of the instruction, the name(s) of the attendee(s), and the name(s) of the individual(s) who provided the instruction.

X-RAY GENERATING DEVICES

These procedures are taken from the NCRP Report No. 102, "Medical X-Ray, Electron Beam and Gamma-Ray Protection for Energies up to 50 MeV (Equipment Design, Performance and Use)", NCRP Report No. 105, "Radiation Protection for Medical and Allied Health Personnel", and the “Regulations for Control of Radiation in Mississippi”. Although these procedures were developed for human use of x-ray devices, their basic safeguards also apply to the non-human use of x-ray devices (for research purposes). These procedures are to be followed by all personnel using x-ray devices. Deliberate exposure of an individual to the x-ray device’s useful beam for training or demonstration purposes shall not be permitted, unless there is a diagnostic need for the exposure, and the exposure is prescribed by a dentist or physician.

As a general rule, any technique or procedure that reduces the number of retakes and patient exposure reduces the exposure to radiological personnel. Technologists are responsible for knowing and using proper techniques, positioning, image receptor (image intensifier, image mode, etc.), appropriate shielding, and collimation with each patient. It is imperative that the technologist understands the effects of all technique factors on overall image quality. It is also important for the technologist to understand the differences among the types of image receptors

used in radiology and the effects of these different image receptors on patient and personnel exposure.

General Guidelines

A. Each department using x-ray-generating devices shall establish and make available to x-ray technologist or operators, written safety procedures, including patient holding and any restrictions of the operating technique required for the safe operation of the particular x-ray system. The technologist or operator shall be familiar with these procedures.

B. Particular care should be taken to limit the useful beam to the smallest area consistent with clinical requirements and to align accurately the x-ray beam with the patient and image receptor.

C. Sensitive body organs (e.g. lens of the eye, gonads) should be shielded whenever they are likely to be exposed to the useful beam provided that such shielding does not eliminate useful diagnostic information or proper treatment.

Comment: Gonadal shielding of not less than 0.5-millimeter lead equivalent material should be used for patients who have not passed the reproductive age, during radiographic procedures in which the gonads are in the useful beam, except for cases in which this would interfere with the diagnostic procedure. However, shielding should never be used as a substitute for adequate beam collimation and alignment.

D. Protection of the embryo or fetus during radiological examination or treatment of women known to be pregnant should be given special consideration.

E. When a patient must be held in place for radiography or fluoroscopy, mechanical supporting or restraining devices should be used. If an individual must physically hold the patient, that individual shall be protected with appropriate shielding devices, such as protective gloves, apron, and thyroid shield. The individual should be so positioned that the useful beam will strike no part of the body and that the body is as far as possible from the edge of the useful beam.

F. Only persons whose presence is necessary shall be in the radiographic or fluoroscopic room during exposure. All such persons shall don all appropriate protective apparel.

G. The x-ray technologist or fluoroscopist shall stand behind the protective barrier during radiographic exposures.

H. The x-ray technologist or fluoroscopist should use the maximum source to skin distance (SSD) consistent with medical requirements of the procedure.

I. Special care shall be taken to ensure adequate filtration in radiographic or fluoroscopic machines.

J. Particular care shall be taken to ensure adequate filtration in any machine equipped with a beryllium window tube. Appropriate added filter is required to provide the recommended filtration values.

K. Radiation source systems and imaging systems, as well as film and xerographic processors should be subjected to appropriate quality assurance programs with documentation, in order to minimize the unproductive application of radiation.

L. The image receptor used in a given radiographic examination should have the highest speed consistent with the diagnostic objective of the examination.

M. Radiographic films should not be used beyond the expiration date included in the manufacturer's recommendations and appropriate shielding shall be used to adequately protect unprocessed film.

N. Radiographic image receptors should be cleaned according to the instructions of the manufacturer and should be evaluated periodically for adequate function at intervals not exceeding six months.

O. Individuals operating radiographic or fluoroscopy equipment must wear personal dosimetry devices provided by the facility. When wearing protective clothing (lead aprons, etc.), the dosimetry device must be worn on the outside of protective clothing, on the front portion of the body, and at or near collar level.

P. The tube potential (kilovoltage), filtration and source-skin distance (SSD) employed in fluoroscopic examinations should be as large as practical, consistent with the objectives of the study.

Q. The x-ray technologist or operator should use the maximum SSD consistent with medical requirements of the procedure. For radiographic or fluoroscopic procedures, distances of less than 30 cm (12 in) shall not be used and distances of less than 38 cm (15 in) should not be used.

R. The smallest practical field sizes and the shortest irradiation time should be employed.

S. Each person (except the patient) shall wear protective aprons of at least 0.5-mm lead equivalent material in the radiography or fluoroscopy room if they may be exposed to the useful beam.

Comment: The x-ray technician, operator, other staff, ancillary personnel, and other persons required for the medical procedure but are not exposed to the useful beam shall be protected from the direct scatter radiation by protective apron or whole body protective barriers of not less than 0.25 millimeter lead equivalent material. People who must move around the room during the procedure should wear a wraparound protective apron.

T. In those cases where the patient must hold the image receptor, except during intraoral examination, any portion of the body other than the area of clinical interest struck by the useful beam shall be protected by not less than 0.5-millimeter lead equivalent material.

U. The hand of the x-ray technologist or fluoroscopist shall not be placed in the useful beam unless the patient and a protective glove of at least 0.25-mm lead equivalent material to attenuate the beam.

V. Film in darkrooms or in film storage areas should not be exposed to more than 0.0002 cGy (0.2 mrad) of stray radiation prior to development.

W. Medical fluoroscopy should be performed only by or under the immediate supervision of physicians properly trained in fluoroscopy procedures.

Stationary Fluoroscopic Equipment

In addition to the above-mentioned general procedures, stationary fluoroscopy equipment has a few specific guidelines that should be followed any time fluoroscopy is being performed.

A. Fluoroscopy should not be used as a substitute for radiography, but should be reserved for the study of dynamics or spatial relationships or for guidance in spot-film recording of critical details.

B. The exposure rate used in fluoroscopy should be as low as is consistent with the fluoroscopic requirements.

> **Comment:** In cineradiography, special care should be taken to limit patient exposure when, as is often the case, tube currents and potentials employed are higher than those normally used in fluoroscopy. The exposure rates to which patients are normally subjected shall be determined periodically.

C. X-ray films, intensifying screens and other image recording devices should be as sensitive as is consistent with the requirements of the examination.

D. Measurements of fluoroscopic tabletop or patient entrance air kerma rates shall be made by a qualified expert and documented at least annually. Measurements shall also be made of air kerma rates for typical spot image exposures.

> **Comment:** Fluoroscopic air kerma rate measurements are especially necessary on apparatus employing imaging devices in which brightness is automatically controlled. Such measurements require the use of an attenuation block in the fluoroscopic beam.

E. The air kerma rate used in fluoroscopy should be as low as is consistent with the fluoroscopic requirements and should not normally exceed 5 rad/min (g cGy/min) (measured in air) at the position where the beam enters the patient.

> **Comment:** The fluoroscopist should be aware of the air kerma levels associated with the various modes of operation. In procedures where spot image cameras are used and where multiple images are easily obtained, this operator must be fully aware of the manner in which exposures are made and must exercise great care to assure that only required exposures are made.

F. Non-intensified fluoroscopy shall not be used.

G. Where fluoroscopy is performed with an undertable image intensifier and overhead tube, palpation shall be achieved only with mechanical devices.

H. The fluoroscopist's eyes should be sufficiently dark-adapted for the visual task required before commencing fluoroscopy. Under no circumstances should the fluoroscopist attempt to compensate for inadequate adaptation by increasing the exposure factors employed or by prolonging the fluoroscopic examination.

> **Comment:** The perception of detail under conditions of scotopic vision requires retinal adaptation. The adaptation time necessary for the competent performance of a specific visual task depends on the nature of the task itself, the per-exposure luminance level and color, the conditions of adaptation, and a number of other physiological factors. While wearing red goggles for 10 minutes will usually satisfy adaptation requirements in fluoroscopy, no specific adaptation period can be recommended for all situations. Dark adaptation normally is not necessary when using image intensifiers.

I. Extraneous light that interferes with the fluoroscopic examination shall be eliminated.

Mobile Equipment

In addition to the above-mentioned general procedures, mobile equipment has a few specific guidelines that should be followed any time radiography or fluoroscopy is being performed.

A. Whenever possible, the x-ray technologist or operator shall stand at least 2 m (6 ft.) from the patient, the x-ray tube and the useful beam during radiographic procedures.

B. Measurements of mobile fluoroscopic tabletop and/or patient entrance air kerma rates shall be made by a qualified expert and documented at least annually.

> **Comment:** Fluoroscopic air kerma rate measurements are especially necessary on apparatus employing imaging devices in which brightness is automatically controlled. Such measurements require the use of an attenuation block in the fluoroscopic beam.

C. The air kerma rate used in mobile fluoroscopy should be as low as is consistent with the fluoroscopic requirements and should not normally exceed 5 rad/min (5 cGy/min) (measured in air) at the position where the beam enters the patient.

D. Mobile equipment should be used only for examinations when it is not practical to transfer patients to fixed radiographic or fluoroscopic installations.

E. The responsible medical supervisor shall assure that operators of mobile equipment understand the proper use and limitations of the equipment to avoid needless exposure of the patient and other persons in the vicinity during equipment use.

F. The x-ray technologist or operator shall determine that no person other than the patient will be exposed to the useful beam. The radiographer shall ensure that all persons other than the patient are as far from the mobile unit as their duties and condition will allow.

G. Human patients who cannot be removed from the room shall be protected from the direct scatter radiation by whole body protective barriers of not less than 0.25 millimeters lead equivalent material, or shall be so positioned that the nearest portion of the body is at least 2 meters from both the tube head and the nearest edge of the image receptor.

Mammography X-Ray Equipment

In addition to the above-mentioned general procedures, mammography equipment has a few specific guidelines that should be followed any time radiography is being performed.

A. Compression shall be used in all mammographic procedures.

B. Imaging techniques should minimize exposure times by use of sufficiently high mA values, in order to avoid unnecessary dose increase due to reciprocity law failure.

C. A mammographic unit that is designed for a specific purpose should only be used for that purpose.

Cardiac and Special Procedures Radiographic Equipment

In addition to the above-mentioned general procedures, cardiac and special procedures equipment has a few specific guidelines that should be followed any time radiography or fluoroscopy is being performed.

A. Measurements of fluoroscopic tabletop or patient entrance air kerma rates shall be made by a qualified expert and documented at least annually. Measurements shall also be made of air kerma for typical spot image exposures.

Comment: Fluoroscopic air kerma rate measurements are especially necessary on apparatus employing imaging devices in which brightness is automatically controlled. Such measurements require the use of an attenuation block in the fluoroscopic beam.

B. The air kerma rate used in cardiac and special procedures fluoroscopy should be as low as is consistent with the fluoroscopic requirements and should not normally exceed 5 rad/min (5 cGy/min) (measured in air) at the position where the beam enters the patient. Total fluoroscopic time should be kept as short as possible consistent with cardiac and special procedures imaging requirements.

Comment: The fluoroscopist should be aware of the air kerma levels associated with the various modes of operation. In cine and serial imaging procedures where spot image cameras are used and where multiple images are easily obtained, this individual must be fully aware of the manner in which exposures are made and must exercise great care to assure that only required exposures are made.

C. Non-intensified fluoroscopy shall not be used.

D. When possible, the fluoroscopist and all other personnel required to be in the room should step back from the table and behind portable shields during cine-fluorographic and serial radiography procedures.

Comment: This action can decrease the exposure of the fluoroscopist and other near personnel by a factor of three or more.

E. In serial radiography, the number of images per second and the duration of the procedure should be kept to a minimum consistent with the needs of the examination.

F. All personnel not required in the room shall leave the room during serial radiographic exposures.

Computed Tomography Equipment

In addition to the above-mentioned general procedures, computed tomography equipment has a few specific guidelines that should be followed any time radiography or fluoroscopy is being performed.

A. The slice thickness should be as great as practicable and the number of slices per study should be as few as practicable.

B. Contrast studies should be made only when necessary for obtaining critical diagnostic information.

C. The user shall be familiar with the relationship between the patient dose (both the maximum value and its distribution) and the operation technique factors (kVp, mAs per scan, slice thickness) for the computed tomographic unit. This information, as well as information describing the absorbed dose per scan and the absorbed dose distribution for multiple scans for various appropriate phantoms, technique factors and scan increments shall be provided by the equipment manufacturers.

D. A qualified expert shall conduct annual surveys.

Dental X-Ray Equipment

The Dental x-ray guidelines are taken from the “Regulations for Control of Radiation in Mississippi”.

A. Deliberate exposure of an individual to the useful beam for training or demonstration purposes shall not be permitted unless there is a diagnostic need for the exposure and a dentist or physician prescribes the exposure.

B. The operator or the assistant shall not hold the film in place for the patient during the exposure.

C. During each exposure, the operator shall stand as far as practical from the patient and outside the path of the useful beam (at least six feet from the x-ray tube) or behind a suitable barrier.

D. Only persons required for the radiographic procedure should be in the radiographic room during exposure. All persons shall be adequately protected.

E. The tube housing shall not be hand held during the exposure.

F. Intraoral fluoroscopy shall not be used in dental examinations.

G. As a general principle, the exposure to the patient shall be kept to the practical minimum consistent with clinical objectives.

H. Devices or film holders are available for holding intraoral x-ray films in the mouth. These devices eliminate the need for the patient to hold the film packet with their hand and aid in positioning and stabilizing the film.

I. With conventional radiographic projections, the direct exposure of the gonads to the useful beam does not occur and the use of a lead apron is not indicated. In proper dental radiography, gonadal exposure of the patient is due almost always to the scattered radiation alone. Although the gonadal exposure of the dental patient is extremely small when these recommendations are followed, a further reduction in gonadal exposure is possible with the use of gonadal shielding.

J. The x-ray films used should be as sensitive as is practical and consistent with the requirements of the examination.

Comment: The use of high-speed film is an effective means of reducing the exposure to both the patient and the operator, and the use of fast film lowers the workload in most private dental installations enough to eliminate the need for protective barriers. However, lower speed films having higher resolution may be necessary for some examinations requiring radiography of fine detail.

K. The x-ray beam and the film shall be aligned very carefully with the area to be radiographed.

Comment: Improper technique that results in faulty image geometry increases the exposure of the patient and personnel by requiring the examination to be repeated.

L. Film processing materials and techniques should be those recommended by the x-ray film manufacturer or those otherwise tested to ensure maximum information content of the processed x-ray film. Where practical, quality control methods should be employed to ensure optimum results.

M. Individuals operating dental x-ray equipment may request a personal dosimetry device if they wish to monitor their exposure. Also, personnel who become pregnant and wish to declare their pregnancy will be issued personal dosimetry devices for both mother and child.

Comment: The Radiation Safety Office has reviewed several years' worth of exposure records for personnel performing dental x-rays and did not see any personnel exposures that exceeded the 10% of the annual limit that requires monitoring. Therefore, the requirement for monitoring of all dental x-ray personnel has been rescinded and dosimetry is provided on an as-needed basis as determined by the departmental management and the Radiation Safety Office.

Analytical X-Ray Equipment

A. Each device shall be labeled "Caution Radiation - This Equipment Produces Radiation when Energized".

B. Each room housing such a device will be posted to alert workers to the possible use of an x-ray device.

C. Open beam devices must not be used unless:

1. The device is designed to prevent the entry of any portions of the body;

2. The device tube and shutter status is clearly displayed prominently for the device user;

3. The device shutter cannot be opened unless a collimator or coupling has been connected to the radiation port; and

4. The radiation measured at a distance of 5-cm from the surface of the source housing, port or tube housing is less than 2.5 millirems in one hour.

D. Only those individuals approved by the Radiation Safety Committee shall operate analytical x-ray devices.

E. Device interlocks shall not be bypassed. Upon failure of interlocks, operation of the device will cease immediately, until a qualified service representative completes repairs.

F. Individuals operating analytical x-ray equipment may request a personal dosimetry device if they wish to monitor their exposure. Also, personnel who become pregnant and wish to declare their pregnancy will be issued personal dosimetry devices for both mother and child.

Comment: The Radiation Safety Office has reviewed several years' worth of exposure records for personnel performing analytical x-rays and did not see any personnel exposures that exceeded the 10% of the annual limit that requires monitoring. Therefore, the requirement for monitoring of all analytical x-ray personnel has been rescinded and dosimetry is provided on an as-needed basis as determined by the departmental management and the Radiation Safety Office.

Personnel Training Program

Individuals who will be operating x-ray systems or x-ray-generating devices shall be adequately instructed in the safe operating procedures and be competent in the safe use of the equipment. Subject matters pertinent to this requirement include, but are not limited to, the following:

A. Familiarization with equipment

1. Identification of controls

2. Function of each control

3. How to use a technique chart

B. Radiation protection

1. Collimation
2. Filtration
3. Gonad shielding and other patient protection devices, if used
4. Restriction of x-ray tube radiation to the image receptor
5. Personnel protection
6. Grids

C. Image processing

1. Image receptor speed as related to patient exposure
2. Image processing parameters
3. Quality Assurance program

D. Emergency procedures

1. Termination of exposure in event of automatic timing device failure

E. Proper use of personnel dosimetry, if required

F. Understanding units of radiation

Initial training at the time of hire may require one or more of the following:

A. Completion of on-line training on the intranet

B. Site-specific training with the authorized user

C. Training with Radiation Safety Office staff

Annual refresher training may require one or more of the following:

A. Completion of on-line training on the intranet

B. Site-specific training with the authorized user or lab management

C. Training with Radiation Safety Office staff

Training requirements for ancillary personnel

Ancillary personnel are informed of the presence of signs and postings in areas where sources of ionizing radiation are kept or stored when attending orientation as new employees. Annual refresher training is also provided to ancillary personnel.

When working in areas where radiation-generating devices may be energized, ancillary personnel are required to leave the immediate area during the procedure and can only return when the device has been turned off.

RECORD KEEPING

X-Ray Devices

The following information must be kept on file for each x-ray device or system and made available for inspection by MSDH/DRH upon their request:

A. Room number or locations, model and serial numbers of all major components, and user's manuals for those components;

B. Tube rating charts and cooling curves;

C. Records of surveys, calibrations, maintenance, and modifications performed on the x-ray system(s); and

D. A copy of all correspondence with MSDH/DRH regarding each x-ray system.

Each department shall maintain an x-ray log containing the patient's name, the type of examinations, and the dates the examinations were performed. When the patient or film/imaging must be provided with human auxiliary support, the name of the human holder shall be recorded.

Therapeutic Radiation Systems

All records required by the “Regulations for Control of Radiation in Mississippi” shall be retained until disposal is authorized by MSDH/DRH unless another retention period is specifically authorized. All required records shall be retained in an active file from at least the time of generation until the next inspection by MSDH/DRH. Any required record generated prior to the last inspection may be archived as long as a complete copy of said record can be retrieved until such time as is authorized by MSDH/DRH for final disposal.

The following information shall be maintained in a separate file or package for each therapeutic radiation machine:

A. Report of acceptance testing;

B. Records of surveys, calibrations, and periodic quality assurance checks of the therapeutic radiation machine required by the “Regulations for Control of Radiation in Mississippi”, as well as the name(s) of person(s) who performed such activities;

C. Records of major maintenance and modifications performed on the therapeutic radiation machine, as well as the name(s) of person(s) who performed such services; and

D. Signature of person authorizing the return of the therapeutic radiation machine to clinical use after service, repairs, or upgrade.

INSTRUMENT QUALITY CONTROL

Diagnostic X-Ray Devices

A. Devices should be evaluated annually by a qualified expert and calibrated as necessary.

B. The calibrated dosimetry system for diagnostic x-ray devices shall be traceable to a national standard.

Computed Tomography Devices

A. Devices should be evaluated annually by a qualified expert and calibrated as necessary.

B. The calibrated dosimetry system for CT devices shall be traceable to a national standard.

Fluoroscopic X-Ray Devices

A. Devices should be evaluated annually by a qualified expert and calibrated as necessary.

B. The calibrated dosimetry system for fluoroscopic devices shall be traceable to a national standard.

Dental X-Ray Devices

A. Devices should be evaluated annually by a qualified expert and calibrated as necessary.

B. The calibrated dosimetry system for dental x-ray devices shall be traceable to a national standard.

Research X-Ray Devices and Electron Microscopes

A. The Radiation Safety Office, using an ion chamber type survey meter calibrated within the last year, must survey research x-ray devices and electron microscopes annually.

B. The survey results must be recorded for review on the X-Ray Device Survey Form. Any suspect survey meter readings will be promptly reported to the device manufacturer and MSDH/DRH for investigation.

C. Devices must be operated in accordance with the “Regulations for Control of Radiation in Mississippi”.

Accelerators

A. Accelerators used for human treatment must be calibrated at intervals not to exceed one year and after any change or replacement of components. Calibrations must be in accordance with the “Regulations for Control of Radiation in Mississippi”.

B. Accelerators must be surveyed after any change in the facility or equipment. Surveys shall be in accordance with the “Regulations for Control of Radiation in Mississippi”.

C. Accelerators must be periodically spot checked in accordance with the “Regulations for Control of Radiation in Mississippi”.

Irradiators

A. Devices must be surveyed annually by the Radiation Safety Office using a GM tube survey meter calibrated within the last year.

B. The results of the survey will be recorded on the Equipment Survey Form. Any suspect survey meter readings will be promptly reported to the device manufacturer and the Division of Radiological Health for investigation.

Irradiators (Blood Transfusion Services)

A. Training is required prior to the operation of irradiators.

B. Operation instructions will be posted on the side of the irradiator along with a "Notice to Employees" form.

C. A copy of the Irradiator Operating Manual must be kept near the irradiator.

D. When not in use or when not under direct supervision, the irradiator keys are to be stored in a separate location to prevent unauthorized operation.

E. All use of the irradiator in Blood Transfusion services must be coordinated through blood “Transfusion Medicine” and permission must be obtained. All uses of the research irradiator will be coordinated with the Department of Surgery and/or the Radiation Safety Office.

F. Individuals not assigned to Blood Transfusion Services must maintain a use log. The log must specify name, department, sample description (e.g. biohazard, radioactive material, cells, etc.), date and exposure time. A log book is maintained in the room where the irradiator for research is housed.

G. The Radiation Safety Office will leak test the irradiator source semiannually and ambient surveys will be performed quarterly.

PROCEDURES FOR THE USE OF RADIOACTIVE MATERIALS IN ANIMALS

Animal Housing

Areas Housing Animals Containing Radioactive Materials shall be:

A. Properly posted with the following signs and notices (contact the Radiation Safety Office to obtain any of these signs):

1. "Caution Radioactive Material" and/or "Caution Radiation Area" on the outer door as required;

2. "Notice to Employees";

3. "No Eating Drinking or Smoking" on the outer door or inside the room; and

4. "Good Laboratory Practices" and "Emergency Procedures" inside the room;

B. Constructed of durable easily cleanable surfaces, including the surfaces of animal cages;

C. Cleaned periodically to guard against the build-up of contamination; and

D. Surveyed in accordance with the frequency established in this manual.

Laboratory Technicians

Laboratory Technicians or Technologists (primary handlers of animals containing radioactive materials) shall:

A. Be instructed in the safe use of radioactive materials and precautionary measures, as specified in the training requirements of this manual;

B. Be instructed in safe working conditions with animals as required by Animal Facilities; and

C. Wear protective clothing (coveralls, shoe covers, and gloves) when working in possibly contaminated animal areas or handling animals (or carcasses) containing radioactive materials.

Animal Facilities Personnel

Animal Facility personnel shall:

A. Wear protective clothing when working in possibly contaminated animal areas or handling animals (or carcasses) containing radioactive materials;

B. Be given specific instructions by Animal Facilities on cage cleaning and the handling of contaminated animal waste.

Radioactive Animal Waste Disposal

Radioactive animal waste disposal shall be accomplished by:

A. Washing animal waste contaminated with radioactive materials (urine and feces) into the floor drains leading to the sanitary sewer system, unless otherwise instructed by the Radiation Safety Office or the principal investigator for the research being carried out, if waste samples are to be collected.

B. Contaminated animal carcasses and parts shall:

1. Be segregated by isotope (H-3 and C-14 items are to be deposited in the designated containers in the freezer on 8^{th} floor of the Research Wing);

2. Be packaged and identified with a tag with the radiation symbol, name of the principal investigator, isotope, activity (in mCi or uCi), and date of disposal;

3. Be held for decay in storage until surveyed and released by the Radiation Safety Office after they have decayed below regulatory release limits. Note: Carcasses containing H-3 and C-14 that are at activities below 0.05 uCi/gram are disposed of as non-radioactive along with the other carcasses.

AREA SURVEY PROCEDURES

Areas in which radioisotopes are used require periodic surveys with appropriate monitoring instruments or wipe tests. Survey frequency depends upon toxicity, activity, and use with the frequency of survey ranging from daily to monthly.

The Radiation Safety Office will review isotope use in existing and proposed radioisotope laboratories performing research and determine the appropriate survey frequency based on hazards present.

A. Research laboratory hazard classifications are based on the radiotoxicity of the isotope in use, the maximum amounts of activity stored or used in the area, and type of use in terms of the relative hazard of the handling and experimental procedures.

B. Radiotoxicity is used to indicate the relative hazard of the various radionuclides, if deposited internally. The radiotoxicity depends on the energy of the emitted radiation, the chemical and physical form of the material, and the organ in which the material concentrates. Based on these considerations the relative radiotoxicity of typical radioisotopes is given below:

   1. Class I - Very High radiotoxicity (Sr-90, Pb-210, Ra-226, Th-227, Pa-231, U-233, Pu-238, Am-243, Po-210, Ra-228)

   2. Class II - High radiotoxicity (Ca-45, Na-22, Co-56, I-131, Bi-207, Cl-36, Co-60, I-125, Ir-192)

   3. Class III - Moderate radiotoxicity (P-32, S-35, Co-60, Rb-86, Cs-137, Cr-51, Sc-46, Zn-65, Gd-153, C-14, Y-90)

   4. Class IV - Low radiotoxicity (H-3, Kr-85; Tc-99m)

C. Using the data supplied by the user, the Radiation Safety Office will determine the maximum activity of the isotopes that can be used and any special requirements necessary for safe operation.

D. Research laboratories actively using radioactive materials will be surveyed no less than once a month.

E. An authorized user who is not actively using radioactive materials must enter “No Materials Used” under surveys in the EHS (RAM inventory) software interface.

Procedures for performing area surveys in research laboratories

A. Frequent surveys are very important when an authorized user is performing a new task or working with a new isotope or compound. The more frequent the surveys, the better informed the user is of the work environment.

B. Area surveys shall be performed during use, when the work is completed, prior to break periods, and/or at the end of the day. Documentation of such surveys will be required.

C. Personnel monitoring surveys of individual(s) working with the radioactive material shall also be performed during use, when the work is completed, prior to leaving the workstation, prior to break periods, and/or at the end of the day.

D. The weekly and monthly survey shall be performed by the radioactive material user (or their designee) and, depending on the isotope characteristics, shall consist of:

1. A measurement of radiation levels with a survey meter sufficiently sensitive to detect 0.1 mrem/hr in exposure reading or to read in cpm or cps for surface contamination; and/or

2. A series of wipe tests to measure removable contamination levels. The method of performing wipe tests must be sufficiently sensitive to detect 200-dpm per 100 cm^2 for the contaminant involved;

3. A permanent record must be kept of all survey results, including negative results, using the appropriate survey results log in the EHS software interface.

4. Locations found to be contaminated must be decontaminated and resurveyed. Results of the resurvey must be noted on the appropriate section of the software interface.

5. Areas must be cleaned when the contamination level exceeds 200-dpm/100 cm^2, if the counting instrument efficiency is known for the involved contaminate. If the efficiency of the instrument is not known for the involved contaminate, contamination levels are indicated at twice normal background (measured in an area free of any radiation sources).

6. Through the federal and state regulations, varying contamination levels are permissible based on the radioisotope and severity of health risk from exposure; however, for UMMC's purposes all areas posted for the use or storage of radioactive materials shall be subjected to the contamination limits for an unrestricted area due to the following considerations:

    a. Although posted for radioactive material use, laboratories are accessible to workers in surrounding laboratories, other researchers and visitors; and

    b. In some cases, individuals not involved in the use of radioactive materials (other students, technicians, or researchers) share laboratories.

E. The Radiation Safety Office shall perform quarterly surveys in each area using or storing radioactive materials.

1. Each survey shall consist of:

    a. A measurement of radiation levels with a survey meter sufficiently sensitive to detect 0.1 mrem/hr in exposure reading or to read in cpm or cps for surface contamination; and/or

    b. A series of wipe tests to measure removable contamination levels. The method of performing wipe tests must be sufficiently sensitive to detect 200-dpm per 100 cm^2 for the contaminant involved.

2. Results of these quarterly surveys will be documented and maintained in the Radiation Safety Office files. Positive contamination findings will be reported to radioactive material users for action.

3. Quarterly surveys by the Radiation Safety Office are to be unannounced in order to accurately assess the safety precautions being taken in each area using or storing radioactive material.

    a. A representative of the Radiation Safety Office shall have access, at any time, to any area where radioactive materials are used or stored.

    b. If the department or the radioactive material user wishes to provide an escort during these quarterly surveys, the provision of such an escort or representative must not in any way delay the completion of the quarterly survey.

    c. If such a delay appears probable, the representative of the Radiation Safety Office completing the survey has the authority to begin the survey in the area(s) in question immediately.

DECOMMISSIONING AREAS AND EQUIPMENT

Rooms designated for radioactive material use or storage will only be returned to general use after the Radiation Safety Office has completed a decommissioning survey, documented the survey on a Decommissioning Form and determined that contamination was not present. Equipment will not be transferred from a restricted area (an area designated for radioactive material use) to an unrestricted area, until after the Radiation Safety Office certifies that there is no threat of residual radioactive contamination on surfaces. (Small handling devices and tools that can be easily cleaned by the researcher are exempt from this provision provided the researcher thoroughly cleans and surveys these instruments prior to transfer to another area.)

Examples of equipment that cannot be relocated from a posted room without Radiation Safety Office approval includes, but is not limited to, the following:

Sub-zero freezers	Refrigerators
Centrifuges	Microfuges
Incubators	Speedvacs

Liquid Scintillation Counters	Gamma Counters
Water baths	Survey instruments

A. Prior to releasing such a room or equipment item, it will be necessary to contact the Radiation Safety Office and request a radiation survey and swipe test.

B. Surveys will be performed using a thin window GM tube survey meter capable of reading 0.1 mR/hr.

C. Swipes will be taken of a 100-cm^2 area using a filter paper, wipe, or smear dampened with isopropyl alcohol and subjected to liquid scintillation counting.

D. Action levels requiring decontamination will be any survey meter reading greater than twice background or swipe results of equal to or greater than 200-dpm/100 cm^2.

E. Decontamination, if necessary, will be in accordance with procedures listed in the decontamination section of this manual.

F. Once a room or equipment item has been determined to be below stated levels of radioactive contamination (all surveys and swipes measuring less than the action level specified above), the Radiation Safety Office will complete a Decommissioning Form.

G. A copy of this form will be sent to the area supervisor or to the department chairman concerned at their request.

H. A copy of this form will be maintained in the Radiation Safety Office files.

DECONTAMINATION METHODS

Decontamination of Laboratory Surfaces

When contamination is detected on laboratory surfaces and equipment (as a result of regularly scheduled area surveys, surveys at the conclusion of work with radioisotopes, decommissioning surveys, or surveys initiated by a spill), these procedures are to be followed:

A. Identify the area contaminated and the isotopes involved using surveys and swipes;

B. Put on two pair of disposable gloves (one pair over the other);

C. Spray the affected area with a fine mist of a commercial decontamination solution (Radiac Wash for example) or a strong soap and water solution and let the contaminated surface soak briefly; (If the surface cannot be sprayed without dripping and spreading contamination, it is possible to spray the cloths or towels used for decontamination directly.)

D. Place a small plastic bag nearby to hold contaminated trash;

E. Using disposable paper or cloth towels, wipe the contaminated surface from the outer edges to the center, folding the towel repeatedly to prevent the spread of contamination; (If outer gloves become contaminated, remove by turning the first glove inside out. Place

the first glove in a ball in the palm of the second glove. Remove the second glove by turning it inside out. Both contaminated gloves are now bagged one inside the other.)

F. If a thin window survey meter can detect the isotopes, the towel can be surveyed following each application of decontamination solution to check for removable contamination;

G. Survey and/or swipe the contaminated area following each decontamination procedure to measure the effectiveness of the procedure;

H. If the area cannot be successfully decontaminated to Background levels, contact the Radiation Safety Office;

I. Deposit all contaminated trash resulting from decontamination in the appropriate radioactive waste container provided in the department waste collection area (following the container instructions) or contact the Radiation Safety Office for assistance; and

J. Report all spills that result in contaminated surfaces to the Radiation Safety Office.

Decontamination of Glassware

For the decontamination of glassware and other washable containers, these procedures are to be followed:

A. Soak washable containers in a diluted decontamination solution; and

B. Release rinse water into the sink drain, rinse the container, flush the inside surfaces of the sink with running water, and survey or swipe the container, if residual contamination is suspected repeat decontamination.

C. For Iodine-125 contamination on glassware, soaking in a strong bleach solution (50%) overnight has proven effective in reducing contamination levels.

Decontamination of Personnel

For the decontamination of personnel, these procedures are to be followed:

A. General Procedures

1. Personnel decontamination shall be done only under the direct supervision of the Radiation Safety Office.

2. Instruments used must be checked for proper operation and must be calibrated within the past year.

3. Personnel assisting in decontamination shall use necessary precautions and protective clothing to prevent the spread of contamination to them or the surrounding area.

4. Decontamination shall be performed in a manner that will not spread contamination to other parts of the body or into wounds.

5. When washing, caution must be exercised to prevent breaking the skin as this creates the potential for internal contamination.

6. When drying, do not rub the skin as pores will be opened or the contamination will be impressed into the skin.

7. Never use water that is warmer than body temperature for washing as this opens body pores which absorb contamination, creating a more difficult internal contamination. However, to prevent discomfort, do not use water that is excessively cold.

B. Localized skin contamination

1. Inspect the area adjacent to the contamination for any breaks in the skin. If breaks exist and the break is:

   a. A minor scratch or cut, allow the wound to bleed (removing any possible contamination) and proceed with decontamination of the area.

   b. A major cut, contact the Radiation Safety Office and escort the individual to the Student and Employee Health Clinic, or to the UMMC Emergency Department if the injury occurs when the Student and Employee Health Clinic is closed.

2. Document the contamination incident and the actions taken using the Personnel Contamination Report. Note the level of contamination, the isotope, the approximate area of contamination in square inches the location of the contaminated area on the body, and the time, if known, between exposure and the removal of the contamination.

3. If the areas contaminated are the hands or other areas that can be washed without potentially spreading the contamination to other areas of the body or into breaks in the skin, washing with soap and water is acceptable. Avoid excessive roughness that abrades the skin, abrasion increases risk of absorption through the skin.

4. If contamination has been spread to other parts of the body or if skin breaks are possible, the following methods shall be used:

   a. If the area has sparse hair coverage and is dry, press masking tape to the contaminated area. Remove the tape carefully to prevent extraction of hair. Check the tape for contamination to determine effectiveness.

   b. If contamination remains or tape is not practical, wipe the area with a damp gauze square or cotton-tipped swab and soap. Dry the area, and check for residual contamination. Repeat as often as effective using clean gauze or swab for each application.

   c. If (1) and (2) are not effective, sprinkle powdered soap on a gauze square, moisten and make into a paste, and gently rub the affected area. Rinse with clean gauze dipped in water. Dry the area and check for residual

contamination. Repeat as often as effective, using clean gauze for each application.

d. Save all materials used for disposal as radioactive waste. Wash water will be discarded down the drain provided the sink is flushed for several minutes with running water.

5. If the above methods are not effective, a more vigorous method will be required. If so, one of the following steps may be used:

a. Form a paste, using water, powdered soap, and cornmeal. Massage the contaminated area with this paste for five minutes, using a surgical brush for fingernails and callused areas, rinse, dry and monitor.

b. Apply a solution of 30% powdered soap and 70% liquid soap with added water. Rub vigorously for one minute, rinse, dry and monitor.

c. Apply mechanic's waterless hand cleaner, wipe dry and monitor.

C. General body contamination

1. Individuals with general body contamination shall shower immediately in an area that can be controlled and monitored for area contamination.

a. Caution must be exercised to prevent contamination from entering bodily openings or skin breaks.

b. Washing shall start from the neck and proceed downward to ensure all contamination is washed away from previously decontaminated areas. Hair decontamination is covered separately below.

2. Dry and check the individual carefully to determine if any contamination remains. Be sure to check in folds of skin and in areas where contamination may be hidden. Areas not previously contaminated shall also be checked as contamination may have spread to these areas.

3. If localized areas of contamination remain; follow the procedure for localized skin contamination.

D. Hair contamination

1. If present in only a small area, contaminated hair may be cut off.

2. If washing is required, the hair is washed in the sink that is approved for radioisotope usage with the individual in a position that precludes the spread of contamination to other parts of the body (eyes, ears, etc.).

3. Dry the hair and check for remaining contamination. Also check the face, neck, and other areas where contamination could have spread. Rewash as necessary.

4. If three washings do not remove the contamination, cutting the contaminated hair will be required.

E. Contamination of the eyes or mouth

1. The eye or mouth will be flushed with tap water but no other action is to be taken. Flushing of the mouth will be done over a sink to prevent swallowing of the water.

2. Further action will be taken only under the direction of a physician in the Student and Employee Health Clinic.

F. Contamination of the ear

1. Contamination in the outer ear will be removed with soap and water on a cotton-tipped swab using care not to get any water in the ear canal. The swabs shall only be damp and the individual shall tilt his/her head so the ear is downward.

2. Do not flush the ear with water since this would contaminate the ear canal. Take care not to puncture the eardrum.

3. Contamination in the inner parts of the ear or other methods of decontamination of the outer ear will be accomplished only under the direction of a physician from the Student and Employee Health Clinic or the Emergency Room.

G. Contamination of the Nose

1. Have the contaminated individual blow his/her nose into a facial tissue or soft paper towel. Check the nose for further contamination.

2. If contamination remains, a damp cotton-tipped swab will be used. It is generally better if the contaminated individual performs this procedure.

a. Insert the swab carefully into the nostril as far as possible. Exercise caution so the swab does not touch the side during insertion.

b. Press the swab lightly against the sides of the nostril and withdraw in a circular motion so all sides of the nostril are wiped. Check the swab for contamination.

c. Continue as long as effective or until the nostril becomes tender.

H. Personnel with contamination in the nose or mouth, shall not eat, drink or smoke until the Radiation Safety Office has determined the risk of internal contamination.

I. For personnel with contamination in the nose or mouth, swabs will be taken and analyzed before and after decontamination to determine isotope, activity, and decontamination effectiveness. Bioassays will be required for the determination of any biological uptake. The results of these analyses will be documented on a Bioassay Record and maintained for review along with the Personnel Contamination Report Form.

WASTE DISPOSAL

Radioactive waste must be segregated and disposed of in accordance with state and federal regulations. Radioactive waste disposal is accomplished by decay in storage, release to the sanitary sewer system (provided the release limits and conditions specified in the "Regulations for Control of Radiation in Mississippi" are met), and broker disposal using a licensed and approved radioactive waste broker.

A. Radioactive Waste Classification

Radioactive waste is divided into the following categories based on isotopes, isotope properties, waste form and the presence of other waste components (chemical, biological, etc.):

Type I Mixed solids/vials containing isotopes with less than 120-day half-lives and free of any hazardous chemicals - biodegradable, non-hazardous scintillation fluids acceptable. This category can be further subdivided at the collection points into:

a. Dry uncompacted solids and vials of liquids free of biological or animal components and

b. Dry uncompacted solids and vials contaminated with biological or animal components.

Type II Uncompacted solids, containing isotopes with half-lives greater than 120 days and free of any hazardous chemical or biological or animal wastes.

Type III Mixed solids/vials containing isotopes with half-lives greater than or equal to 120 days and free of hazardous chemicals, but containing biological or animal wastes.

Type IV Vials containing isotopes with half-lives greater than or equal to 120 days and containing either aqueous fluids or hazardous chemicals but lacking biological or animal wastes (i.e. scintillation fluids).

Type V Bulk liquid wastes generated (or collected) during analyses and free of any hazardous chemicals. This category can be further subdivided at the collection points into:

a. Liquids containing isotopes with half-lives greater than or equal to 120 days including liquids containing trace amounts of biological or animal wastes (blood, serum, and other fluids); and

b. Liquids containing isotopes with half-lives less than 120 days including liquids containing possible trace amounts of biological or animal wastes.

Type VI Bulk liquid wastes generated (or collected) during analyses and containing hazardous chemicals. This group can be further subdivided at collection points into:

a. Liquids containing isotopes with half-lives greater than or equal to 120 days including liquids with traces of biological or animal wastes.

b. Liquids containing isotopes with less than 120 day half-lives including liquids with trace amounts of biological or animal wastes.

Type VII Animal carcasses and tissue can be subdivided at the time of storage into:

a. Animal carcasses (tissue) containing 0.05 microcuries per gram of weight or less of C-14 or H-3;

b. Animal carcasses (tissue) containing greater than 0.05 microcuries per gram of weight of C-14 or H-3 and/or other isotopes with half-lives greater than or equal to 120 days;

c. Animal carcasses (tissue) containing isotopes with less than 120 day half-lives.

Type VIII Damaged laboratory supplies and utensils (glassware, containers, etc.) can be subdivided at the time of disposal into:

a. Items contaminated with isotopes having half-lives greater than or equal to 120 days;

b. Items contaminated with isotopes having half-lives less than 120 days;

c. Items decontaminated - free of any residual contamination or exhibiting less than 200-dpm/100 cm^2 when the surface is wipe tested.

B. Containers Required by Each Department

The method of radioactive waste disposal varies with the type of waste generated. Each department has access to central collection sites for commonly generated radioactive wastes. These collection areas are posted with "Caution Radioactive Material signs, "Notice to Employee" signs, "No Eating Drinking Smoking" signs, and emergency posters. Each of these areas shall be secure, with a door that can be locked.

Refer to section A. above to determine the type of waste generated, then refer to the methods of disposal as listed below to determine which storage container in the departmental collection area to use:

I.A. Mixed solids/vials containing isotopes with half-lives less than 120 days and free of any biological waste or hazardous chemicals - biodegradable, non-hazardous scintillation fluids acceptable. This drum will be prepared for decay in storage and disposal at a licensed landfill.

I.B. Mixed solids/vials containing isotopes with half-lives less than 120 days and free of any hazardous chemicals - biodegradable, non-hazardous scintillation fluids acceptable - but containing biological agents. This drum will be

prepared for decay in storage followed by shipment to a waste broker as medical waste.

II. Uncompacted solids, containing isotopes with half-lives greater than or equal to 120 days and free of hazardous chemical or biological wastes. This drum will be prepared for shipment to a waste broker.

III. Mixed solids/vials containing isotopes with half-lives greater than or equal to 120 days and free of hazardous chemicals, but containing biological or animal wastes. This drum will be prepared for shipment to a waste broker.

IV. Vials containing isotopes with half-lives greater than or equal to 120 days containing either aqueous fluids or hazardous chemicals but lacking biological or animal wastes. The broker will not process a vial drum if it contains general laboratory wastes such as gloves, bags, paper towels, etc. Only vials can be placed in this container.

Note: Animal carcasses are stored in the freezer units on 8th floor of the research wing and are divided by isotope as the storage containers within the freezer unit indicated.

C. Containers Required by Each Laboratory

1. Each laboratory posted for radioactive material must have appropriate containers were applicable:

   a. A sharps container labeled "Caution Radioactive Material". If necessary two separate containers will be utilized. One for isotopes with half-lives less than 120 days and one for isotopes with half-lives greater than or equal to 120 days.

   b. Sufficient durable, fiber board boxes or other lidded containers with plastic liners and "Caution Radioactive Material" labels to sort waste as needed for the central collection drum until transfers to these waste drums can be made. (Radioactive waste containing vials with biological wastes, blood and other fluids, shall be bagged and taken to central collection drums immediately to reduce odor in laboratories.)

   c. Plastic red biowaste bags for double bagging animal carcasses and tissue.

   d. If research generates non-aqueous, hazardous fluids (not contained in vials) mixed with radioisotopes, an appropriate sealable container labeled "Caution Radioactive Materials" will be required for collection of hazardous/radioactive mixtures. Since this liquid may be required to be solidified prior to disposal, non-hazardous solutions suitable for sewage disposals are strongly recommended to reduce disposal costs.

2. One fiberboard box or other appropriate container with a plastic liner marked for disposal of uncontaminated broken glassware as ordinary trash. Broken glassware

or uncontaminated sharps shall not be placed in the labeled sharp container for radioactive waste disposal.

D. Disposal of Waste in the Collection Areas

1. Each collection area has multiple containers for different types of waste. Each waste container in each waste collection area bears a drum disposal log that identifies the solid radioactive waste to be deposited in that particular drum or container. Do not put waste in the incorrect drum; this unnecessarily increases disposal charges and may even prevent the pickup and disposal of a container. Personnel not sorting waste properly may be called upon to, under the supervision of the Radiation Safety Office, sort through the container and sort the waste properly to allow for disposal. Otherwise, a department will have to fund the disposal of a container that, because of improper sorting, costs much higher than normal charges.

2. The individual depositing waste in a disposal container or drum must ensure that:

   a. Only the waste specified on the drum and sorted by appropriate type is deposited in the drum;

   b. Each deposit is recorded on the drum log, including the date of disposal, principal investigator's name, isotope, and activity in mCi or uCi;

   c. Ensure all information entered onto the drum log is clearly legible and transferred to the carbon copy; and

   d. The Radiation Safety Office is notified if the drum is filled or the form needs to be replaced.

3. Mixed radioactive waste or drums with improperly identified contents will not be removed by the Radiation Safety Office for storage or disposal until the contents have been properly identified.

4. The Radiation Safety Office will not pick up drums containing biological waste in red bags, unless it is a designated drum for biological waste. Red bags found in the short half-life containers held for decay and disposal at the landfill will delay pickup until the waste has been sorted properly.

5. The Radiation Safety Office will replace filled drums after notification that the container is full. The container will be surveyed, sealed, documented and disposed of in accordance with the methods specified in this manual and meeting all regulatory requirements.

E Liquid Waste Disposal

1. Liquid waste containing hazardous chemicals in addition to radioactive materials shall be collected in a glass or plastic container with a lid and labeled with a "Caution Radioactive Material" tag and have the principal investigator, date, isotope, activity, and chemical compounds noted on the container. The Radiation

Safety Office will pick up the container and make arrangements with the Hazardous Materials Office for disposal in accordance with applicable state and federal regulations.

2. Liquid wastes known to contain infectious biological waste shall not be released into the sanitary sewage system. However,

   a. Due to the extremely small quantity of human cells found in RIA samples, the lengthy sewage treatment process, the limited survival of most pathogens outside the human body, and the low probability that the virulent pathogens are present in significant numbers, RIA samples containing traces of radioactive material but free of hazardous and flammable chemicals can be released into the sewage system.

   b. This will reduce the need for both storage of bulk liquid wastes for decay and the extremely difficult solidification of liquids for expensive broker disposal.

3. Liquids containing trace amounts of radioactive material, but free of any hazardous or flammable chemicals and readily soluble or dispersible in water, will be disposed of via the sanitary sewer system provided:

   a. The daily disposal of radioactive material by a single radioactive material user when averaged over a one-month period must be limited to the quantities listed below, unless otherwise specified by the Radiation Safety Office:

Calcium-45	=	5 uCi
Carbon-14	=	10 uCi
Chlorine-36	=	1 uCi
Chromium-51	=	10 uCi
Cobalt-57	=	5 uCi
Gallium-67	=	10 uCi
Hydrogen-3	=	50 uCi
Indium-111	=	10 uCi
Iodine-125	=	10 uCi
Iodine-131	=	10 uCi
Iron-55	=	1 uCi
Iron-59	=	1 uCi
Phosphorus-32	=	20 uCi
Phosphorus-33	=	10 uCi
Rubidium-86	=	1 uCi
Scandium-46	=	1 uCi
Sodium-22	=	1 uCi
Sulfur-35	=	25 uCi
Technetium-99m	=	25 uCi
Thallium-201	=	10 uCi
Yttrium-90	=	1 uCi

1) The above values are conservative activities to ensure that the facility's monthly sewer release limits are maintained below regulatory limits.

b. Likewise, the total quantity of radioactive material released into the sewage system in any one month, when diluted by the average monthly quantity of water released by the facility, will not result in an average concentration exceeding the limits specified in the regulations.

c. The total activity of radioactive material, excluding Hydrogen-3 and Carbon-14, released into the sewage system in any one year must not exceed one curie. The quantities of Hydrogen-3 and Carbon-14 released into the sewage system shall not exceed 5 curies and 1 curie respectively.

F. Sharps Disposal

1. All syringe needles and other sharps used with radioisotopes shall be placed in a sharps container and maintained in each research laboratory.

a. These sharp containers shall be designated only for sharps contaminated with radioactive material. (Radioactive and non-radioactive sharps shall not be mixed for disposal.)

b. Sharps contaminated with isotopes having less than 120 day half-lives shall be segregated from sharps contaminated with longer lived isotopes.

c. All sharp containers must be labeled with a "Caution Radioactive Material" sticker and must indicate the principal investigator's name, date, isotopes present, and activity of each isotope.

d. If deemed necessary by the Radiation Safety Office (based on surveys), the sharp containers will be shielded to reduce radiation levels in the laboratory.

2. Full containers shall be sealed with tape and the principal investigator's name, date, isotope and activity shall be noted on the label of the container. Place the sharp container in the departmental collection room or call the Radiation Safety Office for pickup and disposal.

G. Disposal of Radioactive Animal Wastes

Freezers are specifically designated in the Research Building 8th floor animal area for the short-term storage of radioactive animal wastes. Instructions for radioactive animal disposals are posted in the freezer area. These freezers will be used exclusively for radioactive animal carcasses and parts disposal. Locks on the doors must be kept locked at all times. Keys to the locks can be obtained through the Radiation Safety Office.

1. Multiple bins are provided in the walk-in freezers unit designated for use by the laboratories. These bins are in place for sorting the animals or tissues by isotope. When the bins are full, call the Radiation Safety Office.

2. Radioactive tags are available in the area. Complete the information requested on the tag prior to placing items in the freezer. Be sure to include the principal investigator's name, the date, isotope, and activity in uCi or mCi.

3. Only animal carcasses, parts and tissue containing radioisotopes are to be placed in the 8th floor freezer units posted with a "Caution Radioactive Material" label on the door. No blood vials, syringes, needles, paper, gloves, etc. are to be placed in these units.

4. All animal carcasses, parts, and tissue shall be double bagged in red biowaste bags, tied shut, and tagged with a "Caution Radioactive Material" tag. CRM tapes will not stick to plastic subjected to temperature changes and is therefore not acceptable for package tagging.

5. Items other than animal carcasses and parts (excluding sharps) contaminated with radioactive materials and also contaminated with blood or other biological fluids are to be bagged in a red biowaste bag. These bags are to be sealed shut to prevent odors and placed in the appropriate radioactive waste storage container for disposal by the Radiation Safety Office.

6. Animal carcasses or tissue will be held for decay and then shipped off-site via the broker used by LAF for all normal carcass disposal. Carcasses containing less than 0.05 uCi per gram of weight of C-14 or H-3 will be disposed of via this method as well.

H. Disposal of Non-Radioactive Waste

1. Non-radioactive waste is not to be disposed of in the radioactive waste disposal drums.

    a. When using high-energy beta/gamma isotopes, gloves, paper, plastics, etc. must be surveyed for radioactive contamination with a thin window GM tube survey meter, and if uncontaminated, must be disposed of as ordinary trash.

    b. When using low-energy beta/gamma isotopes (C-14 or H-3), determine which items are contaminated by assessing lab safety procedures (i.e. no spills occurred, no pipette problems, no radioactive contamination on lab items). If there is any possibility that the waste is contaminated with radioactive material, it must be disposed of in the appropriate radioactive waste disposal drum in the department. Uncontaminated waste must be disposed of in regular trash containers as ordinary waste free of radioactive material.

2. Mixing radioactive and non-radioactive waste in the disposal drums unnecessarily increases the volume of solid uncompacted radioactive waste for disposal and correspondingly increases disposal costs.

3. Non-radioactive items contaminated with blood or animal wastes are not to be disposed of in the radioactive waste storage drums.

a. Blood contaminated wastes are to be collected for disposal as medical waste under the contract for medical waste disposals.

b. Animal carcasses, parts, bedding and wastes are to be disposed of by the Laboratory Animal Facilities Department as medical waste.

I. Final Waste Disposal

Once wastes have been collected by the Radiation Safety Office, they must be either held for decay and then disposed of, or shipped off-site for final disposal via a waste broker. Listed below is the method of disposal for each waste category identified in Section A of the Waste Disposal Section of this manual.

I.A. Decay in storage followed by landfill disposal by a licensed landfill operator.

I.B. Decay in storage followed by disposal as medical wastes.

II. Prepare collection container and ship to waste broker for disposal.

III. Prepare collection container and ship to waste broker for disposal.

IV. Prepare collection container and ship to waste broker for disposal.

V.A. Solidify liquids in container, when necessary, and ship to waste broker for disposal as biological or non-biological contaminated waste.

V.B. Tag, identify and store for decay. Drain disposal if non-biological and medical waste disposal if biological.

VI.A. Ship to waste broker for destruction.

VI.B. Tag, identify and store liquids for decay. Dispose of a chemical waste or organic chemical waste.

VII.A. Collect, survey and dispose of as medical waste.

VII.B. Collect, package and ship to broker.

VII.C. Tag, identify, store in freezer for decay followed by disposal as medical waste.

VIII.A. Prepare collection container and ship to waste broker for disposal.

VIII.B. Decay in storage followed by landfill disposal by a licensed landfill operator.

VIII.C. Dispose of as ordinary waste (glass in designated boxes).

Please keep in mind that all wastes disposed of via the landfill, broker for animal carcasses, or medical wastes must have all radioactive markings defaced prior to disposal. Deface all labels prior to placing them in the collection containers, with the exception of the label

placed on the outside of each animal disposal as those labels will be collected by the Radiation Safety Office at the time of survey prior to final disposal.

GLOSSARY

Definitions

Absorbed Dose: The energy imparted to matter by ionizing radiation per unit mass of irradiated material at the place of interest. The units of absorbed dose are the rad and the gray (Gy).

Accessible Surface: The external surface of the enclosure or housing provided by the manufacturer.

ALARA: "As Low As is Reasonably Achievable" means making every reasonable effort to maintain exposures to radiation as far below the dose limits as is practical, consistent with the purpose for which the licensed or registered activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed or registered sources of radiation in the public interest.

Annual Limit on Intake (ALI): The derived limit for the amount of radioactive material taken into the body of an adult worker by inhalation or ingestion in a year. ALI is the smaller value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) or a committed dose equivalent of 50 rems (0.5 sievert) to any individual organ or tissue. ALI values for intake by ingestion and by inhalation of selected radionuclides are given in the “Regulations for Control of Radiation in Mississippi”.

Authorized Medical Physicist: An individual who meets the requirements stated in the Regulations for Control of Radiation in Mississippi.

Authorized User: A physician, dentist, or podiatrist who meets the requirements of the Regulations for Control of Radiation in Mississippi for diagnostic or therapeutic treatment of patients or human research subjects. For research programs an Authorized User is an individual who has sufficient training and experience to meet the requirements of the Radiation Safety Committee in order to be approved to use radiation.

Background Radiation: Radiation from cosmic sources; naturally occurring radioactive materials, including radon, except as a decay product of source or special nuclear material, and including global fallout as it exists in the environment from the testing of nuclear explosive devices or from past nuclear accidents such as Chernobyl that contribute to background radiation and are not under control of the licensee. Background radiation due to cosmic rays and natural radioactivity in rocks and soil varies with location. "Background radiation" does not include sources of radiation from radioactive materials regulated by the “Regulations for Control of Radiation in Mississippi”. Background radiation can also be defined as the radiation arising from sources other than the one directly under consideration. Beam-Limiting Device: A device that provides a means to restrict the dimensions of the x-ray field. Also called a collimator.

Becquerel: The SI unit of activity. One becquerel is equal to 1 disintegration or transformation per second (dps or tps).

Bioassay: The determination of kinds, quantities or concentrations, and, in some cases, the locations of radioactive material in the human body, whether by direct measurement, in vivo counting, or by analysis and evaluation of materials excreted or removed from the human body.

Calibration: The determination of (1) the response or reading of an instrument relative to a series of known radiation values over the range of the instrument, or (2) the strength of a source of radiation relative to a standard.

Committed Dose Equivalent (HT, 50): Means the dose equivalent to organs or tissues of reference (T) that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

Committed Effective Dose Equivalent (HE, 50): The sum of the products of the weighting factors applicable to each of the body organs or tissues that are irradiated and the committed dose equivalent to each of these organs or tissues.

Computed Tomography (CT): means the production of a tomogram by the acquisition and computer processing of x-ray transmission data.

Contamination: A radioactive substance dispersed in materials or on surfaces where it is undesirable, and particularly in any place where its presence can be harmful. The accepted level of beta/gamma surface contamination for release to an unrestricted area is 200-dpm/100 cm^2.

Control Panel: That part of the x-ray control upon which are mounted the switches, knobs, pushbuttons, and other hardware necessary for setting the technique factors.

Cooling Curve: The graphical relationship between heat units stored and cooling time.

Counts Per Minute (CPM): As detected by the radiation detecting instrument, counts per minute are not equal to disintegrations of the radionuclide atoms per minute. Simple conversions can be made by multiplying counts/minute (alpha) x 2 and counts/minute (beta-gamma) x 10 to be approximately equal to disintegrations per minute. Remembering that 2.2 x 10^6-dpm equals one microcurie and 2.2 dpm equals one picocurie can make translations easier. On beta-gamma instruments (Geiger-Mueller type), 2500 counts/minute are approximately 1 mR/hr. Many survey instruments are calibrated in mR/hr.

Curie: A unit of quantity of radioactivity. One curie (Ci) is that quantity of radioactive material which decays at the rate of 3.7 x 10^{10} transformations per second (tps). Common sub-multiples of the curie are the millicurie and the microcurie. One millicurie (mCi) = 0.001 curie = 3.7 x 10^7 tps. One microcurie (uCi) = 0.000001 curie = 3.7 x 10^4 tps.

Decommission: To remove from service, including decontamination to a level that will permit unrestricted use if necessary.

Deep Dose Equivalent (Hd): Applies to external whole-body exposure and is defined as the dose equivalent at a tissue depth of 1-centimeter (1000 mg/cm^2).

Dose: A generic term that means absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, total organ dose equivalent, or total effective dose equivalent.

Dose Equivalent (HT): The product of the absorbed dose in tissue, quality factor, and all other necessary modifying factors at the location of interest. The units of dose equivalent are the rem and the sievert (Sv).

Dose Limits: The permissible upper bounds of radiation doses established in accordance with the regulations.

Effective Dose Equivalent (HE): The sum of the products of the dose equivalent to each organ or tissue (HT) and the weighting factor (WT) applicable to each of the body organs or tissues that are irradiated.

Evaluation Level: That level at which an intake shall be evaluated beyond the initial bioassay measurement. (For I-125 this will be implemented at an uptake level of 1.2 uCi, and for I-131 this will be implemented at an uptake level of 1 uCi.)

Exposure: Being exposed to ionizing radiation or to radioactive material.

Exposure rate: Exposure per unit of time, such as roentgen per minute and milliroentgen per hour.

External dose: That portion of the dose equivalent received from any source of radiation outside the body.

Extremity: Hand, elbow, arm below the elbow, foot, knee, and leg below the knee.

Field Emission Equipment: Equipment which uses an x-ray tube in which electron emission from the cathode is due solely to the action of an electric field.

Filter: Material placed in the useful beam to absorb preferentially selected radiations.

Gamma Rays: High energy, short-wavelength radiation. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded against by dense materials such as lead or depleted uranium. Gamma rays are essentially similar to x-rays, but are usually more energetic and are emitted from the atom's nucleus.

Geiger-Mueller Counter: Often referred to as a survey meter, it is a radiation detection instrument named for H. Geiger and W. Mueller. When ionizing radiation passes through the gas in the tube, a pulse of electrons is created which passes through an external electrical circuit and is counted. The dial on the instrument can usually be read in counts per minute, counts per second or mR per hour.

Gonad Shield: A protective barrier for the testes or ovaries.

Gray (Gy): The SI unit of absorbed dose. One gray is equal to an absorbed dose of 1 joule per kilogram (100 rads).

Half-life: Often referred to as physical half-life, this is the time required for a radioactive substance to lose 50% of its activity by decay.

High Radiation Area: An area, accessible to individuals, in which radiation levels from radiation sources external to the body could result in an individual receiving a dose equivalent in excess of 0.1 rem (1 millisievert) in 1 hour at 30 centimeters from any source of radiation or 30 centimeters from any surface that the radiation penetrates.

Image Intensifier: A device, installed in its housing, which instantaneously converts an x-ray pattern into a corresponding light image of higher energy density.

Image Receptor: Any device, such as a fluorescent screen or radiographic film, which transforms incident x-ray photons either into a visible image or into another form which can be made into a visible image by further transformations.

Image Receptor Support: For mammographic systems, that part of the system designed to support the image receptor during mammography.

Inspection: An official examination or observation including, but not limited to, tests, surveys, and monitoring to determine compliance with rules, regulations, orders, requirements, and conditions of the "Regulations for Control of Radiation in Mississippi".

Interlock: A device used to assure proper and safe use of a radiation installation by monitoring (usually by electrical devices) the status, presence or position of various associated devices such as source position, collimator opening, beam direction, door closure, filter presence and preventing the production or emission of radiation if the potential for an unsafe condition is detected.

Internal Dose: That portion of the dose equivalent received from radioactive material taken into the body.

Investigational Level: The level at which an intake shall be investigated beyond the initial bioassay measurement and the evaluation level precautions. (For I-125 this will be implemented at an uptake level of 6 uCi, and for I-131 this will be implemented at an uptake level of 5 uCi.)

Irradiation: The exposure of a living being or matter to ionizing radiation.

Isotopes: One of two or more atoms with the same atomic number (same chemical element) but with different atomic weights. An equivalent statement is that the nuclei of isotopes have the same number of protons but different numbers of neutrons. Isotopes usually have very nearly the same chemical properties, but somewhat different physical properties.

Kerma: The sum of the initial kinetic energies of all the charged ionizing particles liberated by uncharged ionizing particles per unit mass of as specified material. Kerma is measured in the same unit as absorbed dose. The SI unit of kerma is joule per kilogram and its special name is gray (Gy). Kerma can be quoted for any specified material at a point in free space or in an absorbing medium.

Kilovolt (kV) [kilo electron volt (keV)]: The energy equal to that acquired by a particle with one electron charge in passing through a potential difference of one thousand volts in a vacuum.

Kilovolts Peak (kVp): The maximum value of the potential difference across the x-ray tube during an exposure. kWs: Kilowatt second.

Lead Equivalent: The thickness of the material in question affording the same attenuation, under specified conditions as lead.

Lens Dose Equivalent (LDE): The external exposure of the lens of the eye that is taken as the dose equivalent at a tissue depth of 0.3-centimeter (300 mg/cm^2).

License: A license issued by the Mississippi State Department of Health/Division of Radiological Health in accordance with the regulations adopted by the state of Mississippi. UMMC holds a Broad Scope Medical License and several other licenses and registrations with MSDH/DRH for operations involving both medical and research uses of radiation.

Licensed Material: Radioactive material received, possessed, used, transferred or disposed of under a general or specific license issued by the Agency.

mA: milliampere.

mAs: milliampere second.

Minor: An individual less than 18 years of age.

Occupational Dose: The dose received by an individual in the course of employment in which the individual's assigned duties involve exposure to radiation and/or radioactive material from licensed and unlicensed sources of radiation, whether in the possession of the licensee, registrant, or other person.

Occupational dose does not include doses from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released in accordance with the regulations, from voluntary participation in medical research programs, or as a member of the public.

Operator: An individual who is certified or qualified to operate x-ray generating equipment by the terms of their professional scope of practice and meets the terms of federal and/or state regulations and UMMC's licenses and registrations.

Patient: An individual or animal subjected to healing arts examination, diagnosis, or treatment.

Penetrating Radiation: A general term used to describe external radiations with sufficient penetrating power that the absorbed dose from exposures to man is delivered in significant quantities to tissues and organs other than the skin. It refers to gamma, x-ray, and neutron radiations.

Phantom: A volume of material behaving in a manner similar to tissue with respect to the attenuation and scattering of radiation.

Protective Apron: means an apron made of radiation absorbing materials used to reduce radiation exposure.

Protective Barrier: A barrier of radiation absorbing material(s) used to reduce radiation exposure. The types of protective barriers are as follows:

A. Primary Protective Barrier: The material, excluding filters, placed in the useful beam, to protect anyone other than the patient from radiation exposure.

B. Secondary Protective Barrier: A barrier sufficient to attenuate the stray radiation to the required degree.

Protective Glove: A glove made of radiation absorbing materials used to reduce radiation exposure.

Qualified Expert: An individual who has demonstrated to the satisfaction of MSDH/Division of Radiological Health that such individual possesses the knowledge, training, and experience to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs.

Rad: A special unit of absorbed dose. One rad is equal to an absorbed dose of 100 ergs per gram or 0.01 joule per kilogram (0.01 gray).

Radiation: Gamma rays, x-rays, alpha and beta particles, high speed electrons, neutrons, high speed protons, positrons, and other atomic particles and electromagnetic radiation consisting of associated and interacting electric and magnetic waves and ultrasonic waves.

Radiation Area: Any area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem (0.05 millisievert) in 1 hour at 30 centimeters from the source of radiation or from any surface that the radiation penetrates.

Radiation Detector: A device, which in the presence of radiation provides a signal or other indication suitable for use in measuring one or more quantities of incident radiation.

Radiation Safety Officer: An individual who meets the requirements of the Regulations for the Control of Radiation in Mississippi.

Radioactive Material: Any solid, liquid, or gas, which emits radiation spontaneously.

Radioactivity: The transformation of unstable atomic nuclei by the emission of radiation, usually accompanied by the emission of ionizing radiation (radiation that displaces electrons from atoms or molecules producing ions).

Radiograph: An image receptor on which the image is created directly or indirectly by an x-ray pattern and results in a permanent record.

Recording: Producing a permanent form of an image resulting from x-ray photons.

Registration: Registration with MSDH/Division of Radiological Health in accordance with the regulations adopted by MSDH/DRH.

Rem: A special unit of any of the quantities expressed as dose equivalent. The dose equivalent in rem is equal to the absorbed dose in rad multiplied by the quality factor (1 rem = 0.01 sievert).

Restricted Area: An area, access to which is limited by the licensee or registrant for the purpose of protecting individuals against undue risks from exposure to sources of radiation.

Roentgen: A special unit of exposure. One roentgen (R) equals 2.58×10^{-4} coulomb per kilogram in air (see "Exposure").

Scattered Radiation: Radiation that, during passage through matter, has been deviated in direction. (See Direct Scattered Radiation)

Shallow Dose Equivalent (Hs): The external exposure of the skin or an extremity, which is defined as the dose equivalent at a tissue depth of 0.007 centimeter (7 mg/cm^2) averaged over an area of 1 square centimeter.

Shutter: A device attached to the tube housing assembly, which can totally intercept the entire cross sectional area of the useful beam and which has a lead equivalency not less than that of the tube housing assembly.

SI: The abbreviation for the International System of Units.

Sievert (Sv): The SI unit of any of the quantities expressed as dose equivalent. The dose equivalent in sievert is equal to the absorbed dose in gray multiplied by the quality factor (1 sievert = 100 rems).

Source to Skin Distance (SSD): means the distance between the source and the skin entrance plane of the patient.

Survey: An evaluation of the radiological conditions and potential hazards incident to the production, use, transfer, release, disposal, or presence of sources of radiation. When appropriate, such evaluation includes, but is not limited to, tests, physical examinations, and measurements of levels of radiation or concentrations of radioactive material present.

Technique Factors: The following conditions of operation:

A. For capacitor energy storage equipment, peak tube potential in kV and quantity of charge in mAs;

B. For field emission equipment rated for pulsed operation, peak tube potential in kV and number of x-ray pulses;

C. For CT x-ray systems designed for pulsed operation, peak tube potential in kV, scan time in seconds, and either tube current in mA, x-ray pulse width in seconds, and the number of x-ray pulses per scan, or the product of tube current, x-ray pulse width, and the number of x-ray pulses in mAs;

D. For CT x-ray systems not designed for pulsed operation, peak tube potential in kV, and either tube current in mA and scan time in seconds, or the product of tube current and exposure time in mAs and the scan time when the scan time and exposure time are equivalent; and

E. For all other equipment, peak tube potential in kV, and either tube current in mA and exposure time in seconds, or the product of tube current and exposure time in mAs.

Total Effective Dose Equivalent (TEDE): The sum of the effective dose equivalent for external exposures and the committed effective dose equivalent for internal exposures.

Total Organ Dose Equivalent (TODE): The sum of the deep dose equivalent and the committed dose equivalent to the organ receiving the highest dose as described in the regulations.

Tube: An x-ray tube, unless otherwise specified.

Tube Rating Chart: The set of curves that specify the rated limits of operation of the tube in terms of the technique factors.

Useful Beam: The radiation emanating from the tube housing port or the radiation head and passing through the aperture of the beam-limiting device when the exposure controls are in a mode to cause the system to produce radiation.

Weighting Factor (W_T): The proportion of risk of stochastic effects (probable effects) for an organ or tissue resulting from irradiation of that organ or tissue compared to the total risk of stochastic effects when the whole body is irradiated uniformly.

X-Ray: A penetrating form of electromagnetic radiation emitted either from the inner orbit electrons of an excited atom as the electrons return to their normal state (orbital shells) or when a metal target (usually tungsten) is bombarded with high-speed electrons (X-ray devices). X-rays are always generated outside the atom's nucleus.

X-Ray Equipment: An x-ray system, subsystem, or component thereof. Types of x-ray equipment are as follows:

A. Mobile X-Ray Equipment: X-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled.

B. Portable X-Ray Equipment: X-ray equipment designed to be hand carried.

C. Stationary X-Ray Equipment: X-ray equipment that is installed in a fixed location.

X-Ray System: An assemblage of components for the controlled production of x-rays. It includes minimally an x-ray high-voltage generator, an x-ray control, a tube housing assembly, a beam-limiting device, and the necessary supporting structures. Additional components that function with the system are considered integral parts of the system.

X-Ray Tube: Any electron tube that is designed to be used primarily for the production of x-rays.

ATTACHMENTS

APPLICATION FOR AUTHORIZATION TO USE RADIOACTIVE MATERIALS OR RADIATION GENERATING DEVICES FOR DIAGNOSTIC OR THERAPEUTIC PURPOSES

Name:_____Department:_____

Employee ID #:_____Campus Email_____

Title:_____Telephone:_____

Requesting use of:_____Radioactive Materials_____Devices

Authorization requested:_____Regular or_____Temporary [until experience documented]

If temporary authorization requested:

Supervisor Name:_____Department:_____

EDUCATIONAL BACKGROUND

TYPE OF INSTRUCTION	LOCATION/ DATES	HOURS	ON THE JOB TRAINING	FORMAL INSTRUCTION
Principles/practices of radiation safety			YES NO	YES NO
Radioactivity monitoring technique and instruments			YES NO	YES NO
Mathematics basic to the use of radiation			YES NO	YES NO
Biological effects of radiation			YES NO	YES NO

FORMAL TRAINING COURSES

List all formal courses pertaining to isotopes, atomic structure, radiochemistry, radiobiology, radiation generating devices [x-rays or gamma rays], etc.

TITLE OF COURSE	LOCATION	DATES	COURSE CONTENT

RADIOACTIVE MATERIALS PREVIOUSLY USED

ISOTOPE	ACTIVITY	LOCATION	DATES	USED FOR

Have you ever been listed as an authorized user on a radioactive material license?___Yes _____No

If yes, provide facility name/address:_____

_____

ISOTOPES REQUESTED FOR USE AT UMMC

ISOTOPE	ACTIVITY	PURPOSE	RADWASTE*

***** Radwaste generated is either one or a combination of: L = non-hazardous liquids; C = chemicals; B = biological; S = solids; LSV = liquid scintillation vials.

List the locations where radioactive materials will be used (building and room number):

_____

Provide a sketch of these locations indicating areas used for isotope work and storage. Number various locations on this sketch to indicate the position of lab survey points in areas where isotopes are used. [Survey frequency will be established later by UMMC Radiation Safety Office.]

List the survey meter or other counting equipment to be used for lab surveys (manufacturer, model number and serial number):_____

_____

RADIATION DEVICES [X-RAY OR GAMMA] PREVIOUSLY USED

DEVICE USED	WHERE USED	DURATION	SUPERVISOR

REQUESTED USE OF RADIATION DEVICES [X-RAY OR GAMMA]

DEVICE (Name, Model, Serial #)	LOCATION (Room #, Dept.)	PURPOSE	OTHERS TO BE SUPERVISED

Application

STATEMENT OF AGREEMENT

The individual named below agrees without reservation of any kind, to abide by the University of Mississippi Medical Center Radiation Safety Manual and the Mississippi State Department of Health Regulations and hereby waives any right to or recourse against the University of Mississippi for any damage whatsoever resulting from any failure to fully conform to said manual, regulation, or policies.

Name (printed): _____ Date: _____

Signature: _____

==========

Date Approved/Disapproved by RSC: _____

RSC Chairman Signature: _____

If disapproved, explanation or conditions:

APPLICATION FOR AUTHORIZATION TO USE RADIOACTIVE MATERIALS FOR RESEARCH PURPOSES

Please type or print legibly. Return to UMMC Radiation Safety Office, Department of Environmental Health and Safety.

Name:_____ Department:_____

Employee ID #:_____ Campus Email_____

Title:_____ Telephone:_____

Please indicate training.

Type of Training	Institutions/Dates	Duration of Training (hours)	On the Job Training	Formal Course
Principles and Practices of Radiation Safety			Yes No	Yes No
Radioactivity Monitoring Technique and Instruments			Yes No	Yes No
Mathematics Basic to the use of Radiation			Yes No	Yes No
Biological Effects of Radiation			Yes No	Yes No

1. List all previous experience with radioactive materials (including isotopes and activity ranges and facilities at which this material was used)._____

2. List all isotopes requested for use at UMMC (including maximum activity to be possessed for each isotope)._____

3. List all laboratory locations where radioactive materials will be used (including building and room number)._____

4. Will any procedures increase volatility of labeled compounds? Yes No

If so, which isotopes?_____

5. Describe precautions taken to reduce contamination and personnel exposure levels (laboratory preparations, shielding, waste storage conditions, etc.)._____

_____

_____

_____

_____

6. If performing iodinations, which laboratory hood will be used?_____

_____

Has the hood's airflow been checked? Yes No If so, when?_____

By whom?_____ Noted cfm_____

Amount of activity (mCi) per iodination:_____

Estimated iodinations per month_____

7. List survey instrumentation to be used (include make, model and serial number)__

_____

_____

_____

8. On a separate sheet, give a brief description of the purposes for the use of each radionuclide, to include:

A. Experimental Procedures

B. Identification of types of labeled compounds

C. Approximate activity per experiment

D. Estimated number of experiments per month

E. Specify laboratory animals (if applicable), and animal husbandry if contamination is a possibility

F. Which types of waste will be generated

9. Instructions and requirements of UMMC Radiation Safety Office and Committee:

A. Use plastic-backed absorbent paper for work areas where radiation will be used.

B. Mark all radiation workstations with "Caution Radioactive Material" tape.

C. Wear buttoned lab coats.

D. Wear gloves.

E. Work in fume hoods when volatile compounds are used.

F. Use beta shields when applicable.

G. Survey radiation work areas after each use and document full surveys at least monthly. Assure appropriate calibrated survey instrumentation is available and used for each isotope in use.

H. Keep radioactive waste collection containers in each laboratory where radiation is used and assure proper labeling for clear identification of radiation.

STATEMENT OF AGREEMENT

The individual named below agrees without reservation of any kind, to abide by the University of Mississippi Medical Center Radiation Safety Manual and the Mississippi State Department of Health Regulations and hereby waives any right to or recourse against the University of Mississippi for any damage whatsoever resulting from any failure to fully conform to said manual, regulation, or policies.

Name (printed): _____ Date: _____

Signature: _____

==========

Date Approved/Disapproved by RSC: _____

RSC Chairman Signature: _____

If disapproved, explanation or conditions:

PREVIOUS OCCUPATIONAL EXPOSURE HISTORY FORM

You have been identified as a UMMC employee who requires a radiation badge. As a requirement of this facility's radioactive material licenses and x-ray device registrations [issued by the Mississippi State Dept. Of Health], the UMMC Radiation Safety Office must obtain any past occupational exposure that you may have received while wearing a radiation badge issued by a previous employer. Complete this form by supplying the name, address, and dates of previous employment where you were issued a radiation badge. You must also provide your social security number and birthday for this office to track your occupational exposure to radiation while employed at UMMC.

CHECK ONE:

☐ I was not issued a radiation badge at any of my previous places of employment.

☐ I was issued a radiation badge by these previous employers (addresses included) on the following dates, and I authorize the release of my exposure histories to the UMMC Radiation Safety Office:

EMPLOYER DATE ADDRESS

_____

_____

_____

_____

Social Security No._____ Date of Birth_____

Title_____ Employee ID No._____

Name [Printed]_____ Signature_____

STATEMENT OF EMPLOYEE TRAINING FORM INSTRUCTIONS

Before a radiation badge can be issued and before you can perform duties involving sources of radiation, you must complete the training as indicated below:

a. If using radioactive material – **Contact Radiation Safety to be enrolled in the appropriate course on Blackboard or Health Stream**

b. If working around x-rays – **Contact Radiation Safety to be enrolled in a course on Blackboard or Health Stream.**

c. Radiologists, radiology residents, physicians, and certified x-ray technologists are exempted from the above noted training. Please indicate these titles above on this form.

Additions will not be made without all documents.

RADIATION BADGE ORDER/TERMINATE FORM

REQUESTING A NEW BADGE:

Occupational limits are set by federal regulation. The annual limit for whole body deep dose is 5,000 mrem; for lens dose is 15,000 mrem; shallow dose is 50,000 mrem; and fetal dose is 500 mrem for the entire gestational period. Radiation monitoring badges are required for personnel likely to receive greater than 10% of the annual limits as indicated above. If you are receiving a radiation monitoring badge it is understood that you could during the course of your work exceed 10% of the limit. Therefore, you are expected to wear the radiation monitoring badge at all times while working. Failure to wear your radiation monitoring badge correctly and at all times results in inaccurate or incomplete exposure records. Radiation monitoring badges are issued monthly or bi-monthly. To exchange the badge, return it to the departmental badge manager and pick up the new badge. Old badges are expected to be returned to the badge manager prior to the 5th of each month so they will be able to check all badges and have them returned to the Radiation Safety Office by the 10th of each month.

Note: Individuals are responsible for making sure their badge is returned to their badge manager prior to leaving for vacation, sabbatical, maternity leave, or any other absence that would prevent them from being present to return their badge at the appropriate time.

Required information:

Name (printed):_____ DOB:_____
Social Security Number:_____ Gender: Male or Female
Employee ID Number:_____ Badge type: Body Ring Fetal
Department:_____ Ring size if applicable: S M L

By signing this form and initiating the order for a radiation monitoring badge I acknowledge that I understand that I must wear the badge that is issued. I recognize that it is my responsibility to properly wear and return the badges as required to accurately monitor my occupational exposures to radiation. I understand that failure to do so can lead to disciplinary action up to termination.

Signature:_____ Date:_____

TERMINATING A BADGE:

Name (printed):_____ Date:_____
Badge Number:_____ ID Number:_____ Type of Badge:_____
Reason for termination:_____
Signature:_____ Supervisor's signature:_____

Submit both the Occupational Exposure History Form and the Statement of Employee Training with this change form. **ADDITIONS WILL NOT BE MADE WITHOUT ALL DOCUMENTS.**

NURSING INSTRUCTIONS FOR PATIENTS TREATED WITH BRACHYTHERAPY SOURCES

Patient's Name:_____

Room No.:_____ Physician's Name:_____

Isotope:_____ Activity:_____

Date and Time of Administration:_____

Date and Time Sources are to be Removed:_____@_____a.m./p.m.

EXPOSURE RATES IN mR/hr

Bedside	1 meter from bed	Entrance to room
_____	_____	_____
_____	_____	_____
_____	_____	_____

COMPLY WITH ALL CHECKED ITEMS

____1. Wear film badge or pocket dosimeter.

____2. Wear disposable gloves.

____3. Place laundry in linen bag and save.

____4. Housekeeping must not enter the room.

____5. Patient must not have visitors.

____6. Patient must not have pregnant visitors.

____7. Patient must not have visitors under 18 years of age.

____8. A dismissal survey must be performed *before* patient is discharged.

____9. Patient must have a private room.

____10. Other instructions (Attached as needed).

IN CASE OF EMERGENCY CONTACT:

The Radiation Oncology Department at (601) 984-2550

Radiation Safety Office at (601) 984-1980

After Hours and Weekends see **On-Call Scheduling** for Radiation Safety or contact Emergency Dispatch at (601) 984-1420

Date:_____

INSTRUCTIONS FOR PATIENTS TREATED WITH THERAPEUTIC DOSES OF IODINE-131, PHOSPHORUS-32, OR GOLD-198

Patient's Name:_____

Room No:_____ Physician's Name:_____

Radioisotope Administered:_____

Date and Time of Administration:_____

Dose Received:_____ Method of Administration:_____

Exposure Rates in mR/hr

Date	Time	Bedside	3 Feet	6 Feet	Door

(Comply with all checked items)

- ❑ 1. Visiting time permitted: _____
- ❑ 2. Visitors must remain _____ from patient.
- ❑ 3. Patient may **not** leave room.
- ❑ 4. Visitors under 18 are **not** permitted.
- ❑ 5. Pregnant visitors are **not** permitted.
- ❑ 6. Personal dosimeters or pocket dosimeters or detectors must be worn.
- ❑ 7. Tag the following objects and fill out the tag:

  door ☐ bed ☐ chart ☐

- ❑ 8. Gloves must be worn while attending patient.
- ❑ 9. Patient must use disposable utensils.
- ❑ 10. All items must remain in room until approved by the Radiation Safety Office.
- ❑ 11. Smoking is **not** permitted.

- 12. Room is not to be released for cleaning until approved by the Radiation Safety Office.
- 13. Other instructions.

___ No need to collect human waste - dispose in toilet and flush 2 times.
___ No collection of fluid samples until notified by Nuclear Medicine

IN CASE OF EMERGENCY CONTACT:

Nuclear Medicine at (601) 952-5413 (pager)

Radiation Safety Office at (601) 984-1980

After Hours and Weekends see **On-Call Scheduling** for Radiation Safety or contact Emergency Dispatch at (601) 984-142

EMERGENCY PROCEDURES FOR SPILLS INVOLVING RADIOACTIVE MATERIAL

Minor Spills

1. Notify: Notify persons in the area that a spill has occurred.
2. Prevent the Spread: Cover the spill with absorbent paper.
3. Clean Up: Use disposable gloves and remote handling tongs. Carefully fold the absorbent paper and pad. Insert into a plastic bag and dispose of in the radioactive waste container. Also insert into the plastic bag all other contaminated materials such as disposable gloves.
4. Survey: With a low-range, thin-window G-M survey meter, check the area around the spill, hands and clothing for contamination. Alternatively, perform a wipe test.
5. Report: Report incident to the Radiation Safety Office.

Major Spills

1. Clear the Area: Notify all persons not involved in the spill to vacate the room.
2. Prevent the Spread: Cover the spill with absorbent pad, but do not attempt to clean it up. Confine the movement of all personnel potentially contaminated to prevent the spread.
3. Shield the Source: If possible, the spill should be shielded, but only if it can be done without further contamination or without significantly increasing your radiation exposure.
4. Close the Room: Leave the room and lock the door(s) to prevent entry.
5. Call for Help: Notify the Radiation Safety Office immediately.
6. Personnel Decontamination: Contaminated clothing shall be removed and stored for further evaluation by the Radiation Safety Officer. If the spill is on the skin, flush thoroughly and then wash with mild soap and lukewarm water.

Radiation Safety Office

Office: (601) 984-1980

After Hours see **On-Call Scheduling** for Radiation Safety or contact

Emergency Dispatch: (601) 984-1420

REMINDER OF GOOD RADIOISOTOPE LABORATORY SAFETY PRACTICES

1. Never pipette by mouth.
2. No smoking or eating, drinking or cosmetics application permitted in the work area.
3. Gloves and laboratory coat must be worn when using radioisotopes.
4. If issued, personnel monitors must be worn.
5. Hands, shoes and clothing shall be frequently monitored.
6. Work with radioactive materials in an approved hood or glove box, unless the safety of working on an open bench can be demonstrated.
7. Radioisotope work should be conducted in an impervious tray or pan, lined with absorbent paper.
8. Utilize shielding and distance whenever possible.
9. Dispose of liquid and solid radioactive waste in the approved manner.
10. Refrigerators containing isotopes shall not be used for storing food.
11. Work areas shall be monitored regularly for contamination.
12. Thoroughly wash hands after manipulating isotopes, before eating or smoking, and on completion of work.
13. Maintain records of receipt, use, transfer and disposal of radioactive materials.
14. Report accidental inhalation, ingestion, injury or spills to your supervisor and the Radiation Safety Office.
15. Review pertinent safety practices frequently, especially before using a new radionuclide.
16. Assure compliance with The University of Mississippi Medical Center Radiation Safety Manual and the MSDH/DRH “Regulation for Control of Radioactive Material in Mississippi”.

Radiation Safety Office

Office: (601) 984-1980

After Hours see **On-Call Scheduling** for Radiation Safety or contact

Emergency Dispatch: (601) 984-1420

RECEIPT OF RADIOACTIVE MATERIALS OUTSIDE OF NORMAL WORK HOURS

All packages containing radioactive material that arrive between 4:30 p.m. and 7 a.m. or on Saturdays, Sundays, or holidays, that is normally delivered to receiving should be taken to the storeroom and placed in a secure or constantly monitored location within the storeroom. Shipping and Receiving personnel will retrieve the package on their next scheduled workday.

An inspection should be made of each package to determine if the package is damaged. If the package is wet or appears to be damaged, immediately contact the Physical Facilities Emergency Dispatch at 984-1420 or the Radiation Safety Office at 984-1980, or contact the radiation safety person on call via the on-line On-Call schedule. Ask the carrier to remain in the hospital until it can be determined that neither he nor the delivery vehicle is contaminated.

Radiopharmaceuticals are typically delivered directly to Nuclear Medicine or Nuclear Cardiology from the nuclear pharmacy during hours when a technologist is present. If a technologist is late or is held up, the package should be taken to the Nuclear Medicine department and placed in the Hot Lab. Campus Police should unlock the door, place the package on the top of the counter, and re-lock the door.

DAILY INCOMING RADIOACTIVE SHIPMENT INSPECTION

DATE	PRODUCT	SUPPLIER	TOTAL SOURCE PER CONTAINER	EXTERNAL RADIATION SURVEY (MR/HR)		WIPE TEST (DPM)			INTERNAL RADIATION SURVEY (MR/HR)	TECH
				Surface	3ft.	BKG	Outside	Inside	SOURCE REMOVED	

*Records may be found digitally on Pinestar Software

IN HOUSE WASTE DISPOSAL RECORD

INSTRUMENT:

SERIAL NUMBER:

DATE STARTED	DATE ENDED	STORED (MR/HR)	DATE DISPOSED	DISPOSED (MR/HR)	METHOD OF DISPOSAL	BKG MR/HR	TECH

RADIOACTIVE WASTE DISPOSAL RECORD

Instructions: It is mandatory that radioactive waste be accounted for regardless of the disposal method. Use this form to record the disposal of radioactive waste materials.

This form is taped to the top of the drum or attached with a clipboard to cardboard collection containers. Log in an estimate of the type of waste and amount of radioactive material each time a disposal is made into the container. When the container is full call the Radiation Safety Office. The container will be collected and replaced with an empty container. This Disposal Record must be collected with the container and will remain with the container until final disposal, whether it is by decay or by a waste broker that handles radioactive wastes.

Name of Authorized User	Date of Disposal	Radioisotope	Estimated Amount (mCi)	Disposal Method

ANIMAL DISPOSAL INSTRUCTIONS

This notice explains in greater detail the proper method for disposing of animal carcasses contaminated with radioactive material. The UMMC Radiation Safety Manual, which is part of the UMMC Radioactive Material License issued by the State Department of Health, describes this process with greater detail. Disposals not complying with these instructions will be tracked to the researcher and returned for proper packaging and tagging.

Note: Only animal carcasses, parts and tissue containing radioisotopes are to be placed in the 8th floor freezer units marked "Caution Radioactive Material". **NO BLOOD OR OTHER VIALS, SYRINGES, NEEDLES, GLOVES, ETC. ARE TO BE PLACED IN THESE UNITS.**

1. Double bag all animal carcasses in re biowaste bags and remove any excess air. Ensure that the bag is tightly sealed.

2. Remove a "Caution Radioactive Material" tag from the pouch taped to the front of the freezer unit.

3. Using a durable marking pen, legibly **print** the following:

   Isotope

   Amount injected into animal

   Date isotope was injected

   Principal Investigator's name

   Department

   Note: Use mCi for millicuries and uCi for microcuries.

4. Attach the tag to the plastic bag by looping the string around the neck of the bag and making a slipknot.

5. Place the tagged bag into the appropriate freezer unit marked "Caution Radioactive Material".

6. Prior to releasing a package for disposal, the UMMC Radiation Safety Office must be contacted to survey the animal carcass. Based on the survey results, the UMMC Radiation Safety Office will decide to release the waste for disposal as medical waste, retain the waste in storage for additional radioactive decay, or package the waste for shipment to a radioactive waste broker.

UMMC RADIATION SAFETY OFFICE

EXTENSION 41980

GUIDE FOR RADIOLOGICAL PROPERTIES OF ISOTOPES

Isotope	Half Life ($t_{1/2}$)	Decay Time 10($t_{1/2}$)	Primary Particle/Ray Emitted	Energy (MeV)	Survey Instrument of Choice
H-3	12.32 years	123 years	Beta	0.019	LSC
C-14	5715 years	57150 years	Beta	0.157	GM or LSC (LSC preferred)
Na-22	2.6 years	26 years	Beta/Gamma	0.546/1.274	GM/NaI
P-32	14.28 days	4.7 months	Beta	1.709	GM
P-33	25.3 days	8.43 months	Beta	0.249	GM
S-35	87.2 days	2.39 years	Beta	0.167	GM
Ca-45	162.7 days	4.46 years	Beta	0.258	GM
Cr-51	27.7 days	9.23 months	Gamma	0.320	GM/NaI
Ni-63	101 years	2.77 years	Beta	0.067	GM/NaI
Ge-68	170.8 days	4.67 years	Positron/Gamma	.511	GM
I-125	59.4 days	1.63 years	Gamma	0.035	LSC/GM (Gamma Counter)
I-131	8.02 days	2.64 months	Beta/Gamma	0.606/0.364	GM/NaI
Ba-133	10.53 years	105.3 years	Gamma	0.356	GM/NaI
Sc-46	83.81 days	2.30 years	Beta/Gamma	0.357/1.12	GM/NaI
Co-57	271.8 days	7.45 years	Beta/Gamma	0.122	GM/NaI
Co-60	5.27 Years	52.7 years	Beta/Gamma	0.1173/0.1332	GM/NaI
Tc-99m	6.01 hours	60.1 hours/2.5 days	Gamma	0.1405	GM/NaI
Tl-201	3.04 days	30.4 days	Gamma	0.167	GM/NaI
In-111	2.80 days	28 days	Gamma	0.245	GM/NaI
Ga-67	3.26 days	32.6 days	Gamma	0.093	GM/NaI
I-123	13.2 hours	5.5 days	Gamma	0.159	GM/NaI
Y-90	2.67 days	26.7 days	Beta	2.281	GM
F-18	1.83 hours	18.3 hours	Beta	0.635	GM
Sr-89	50.52 days	1.4 years	Beta/Gamma	1.488/0.909	GM/NaI
Pd-103	16:.99 days	5.66 months	Beta/Gamma	0.223/0.039	GM
Cs-131	9.69 days	3.23 months	X-ray	0.033	LSC/GM
Sm-153	1.92 days	19.2 days	Beta/Gamma	0.960/0.103	GM/NaI
Gd-153	241.6 days	6.61 years	Gamma	0.097	GM
Ir-192	73.8 days	2.02 years	Beta/Gamma	0.672/0.316	GM/NaI
Ra-223	11.4 days	3.8 months	Alpha/Gamma	5.71/0.269	GM
Ra-226	1,599 years	15,990 years	Alpha/Gamma	4.78.186.2	GM

Note: Half-life and energy ranges were taken from the Chart of the Nuclides - 17th Edition, “Radioactive Decay Data Tables” by David C. Kocher, 1981.

LSC = Liquid Scintillation Counter **GM** = Geiger Mueller **NaI** = Sodium Iodide

UMMC can hold waste for total decay if the half-life is less than 120 days. Any isotope with a half-life more than 120 days must be disposed of through a licensed broker who will deliver it to a licensed facility for storage.

H-3 and C-14 waste is separated from other isotopes for disposal with a licensed broker. Do not mix these isotopes with others if at all possible.

Waste generated with a mixture of radioactive materials and hazardous chemicals should be avoided if at all possible. If mixed waste must be generated, clear this through the Radiation Safety Office and Hazardous Materials Office prior to beginning the procedures to assure proper collection of the waste.

APPENDIX A

Prenatal Training Information

Radiation Safety Office

(601) 984-1980

Declaration of Pregnancy

To: _____

(Name of your supervisor)

In accordance with the Regulations for Control of Radiation in Mississippi, I am declaring that I am pregnant. I believe I became pregnant in _____ (Only the month and year need be provided).

I understand that my occupational radiation dose during my entire pregnancy will not be allowed to exceed 0.5 rem (5 millisieverts), (unless that dose has already been exceeded between the time of conception and submitting this letter). I also understand that meeting the lower dose limit may require a change in job or job responsibilities during my pregnancy.

Prior to being issued a fetal monitoring badge, a completed copy of this form must be submitted to the Radiation Safety Office. In addition, please notify the Radiation Safety Office if you find out that you are not pregnant, your pregnancy is terminated, or after the birth in order to discontinue the fetal monitoring badge.

Training information will be sent to the individual signing below to allow for greater understanding of fetal risks from exposure to radiation. Any questions that may arise following a review of the training information may be addressed to a supervisor or to the Radiation Safety Office.

_____

Signature

_____

Printed Name

_____

Date

RADIATION EXPOSURE AND PREGNANCY

Introduction

The developmental risks associated with radiation exposure to an unborn child during gestation are the focus of this training information. However, you must understand that even under normal physiological conditions, the healthy development of a child is not a 100% guarantee. There are many factors that can affect the healthy conception and development of children. In addition to radiation exposure, some of the other factors may include poor nutrition, age, heredity, certain chemicals, certain drugs (legal and illegal), cigarettes, some viruses, alcohol, and many other factors. Everyone is exposed to these factors at work, at home, for medical diagnosis or treatment, or in the community. These factors can cause reproductive or developmental problems such as infertility, miscarriage, birth defects, low birth weight, abnormal growth and development, and childhood cancer.

As you complete this training, keep in mind that there are many factors in your environment that may affect the development of your child. Occupational exposures to radiation are of minimal increased risk when the UMMC safety polices are adhered to and regulatory limits are maintained in accordance with the institutional ALARA program. The UMMC Radiation Safety Office closely monitors fetal exposures to assure they are below the limitations specified in the regulations. Institutional policies are in place to assure the workplace environment is safe for occupationally exposed workers and their unborn children, and efforts shall be made to keep prenatal exposures below the maximum permissible dose.

Background

In a 1998 review article, the Agency for Toxic Substances Disease Registry (ATSDR) estimated that:

- One in 12 US couples are infertile,
- Forty percent or more of conceptions are lost before the 28^{th} week,
- Two to three percent of newborns suffer a major developmental defect,
- Seven percent of newborns are of low birth weight,
- Five percent of newborns are premature (i.e. born before 37 weeks), and
- An undetermined number suffer from developmental or functional problems.

The extent to which workplace exposures contribute to reproductive and developmental health problems has not been determined to any degree of certainty. However, it is certain that some workplace chemicals and physical factors may cause certain adverse effects. The range of potential adverse outcomes depends on at least three key factors:

- The chemical and/or physical properties of the agent of concern,
- The dose to which an individual is exposed, and
- The timing of the exposure (relative to the development of the fetus).

The potential risks posed by workplace exposures are difficult to assess because of the complexity of human reproductive and developmental processes, the difficulty in differentiating from other contributing factors, difficulties associated with interpreting laboratory tests, and the lack of available human data.

Prenatal Radiation Exposure Policy for Employees

It is the responsibility of all women of childbearing age who wish to declare their pregnancy to notify their supervisor or the Radiation Safety Office as soon as they know or, even suspect that they may be pregnant if their duties involve working in areas where radiation sources are used or stored. A woman who wishes to declare her pregnancy must complete the Declaration of Pregnancy Form, Attachment A to the Radiation Safety Manual, and return it to the Radiation Safety Office.

It is the institutional policy to transfer the employee to a working environment where occupational radiation exposure is negligible. However, it is important to note that an employer cannot force an employee to transfer jobs, resign or take unpaid leave. A pregnant employee may request to remain in her current position whether or not the radiation exposure history shows doses below the maximum permissible dose. Neither can the employee provide the employer with a waiver of liability as a condition of remaining on the job.

If the employee chooses to remain in a position where a radiation exposure potential exists, the department will request an additional radiation-monitoring device for the fetus to monitor prenatal exposures. The fetal monitor shall be worn on the abdomen of the mother, behind a lead apron if one is required. If over-exposure potential is great, a personal dosimeter will be provided for daily determination of exposure levels.

Exposure Limits

Everyone is exposed to radiation every day. People are continuously exposed to low-level radiation found in food, soils, building materials, the air, and from outer space. All of this radiation originates from naturally occurring sources. For example, bananas contain naturally occurring radioactive potassium-40 and air contains radon, a radioactive gas. Your "average natural background" radiation dose is about 300 millirem each year. In addition to natural background radiation, you may be exposed to radiation from medical x-rays and medical radiation tests or treatments throughout each year.

As an occupational worker in an area where sources of radiation are used, you may be exposed to more radiation than the general public. The amount of radiation an occupationally exposed worker is allowed to receive is 5,000 millirem per year.

Individuals under the age of 18 and members of the general public are only permitted to be exposed to 500 millirem per year, which is one-tenth of the annual limit of an occupationally exposed adult. The amount of radiation a fetus is allowed to receive is 500 millirem during the entire gestation period, not to exceed 50 millirem in one month[1].

Prenatal Effects of Radiation

As an individual whose occupation requires that you work directly with radiation sources or at times work in locations designated as restricted areas, it is important that you have a basic understanding of potential biological effects to an unborn baby associated with prenatal radiation exposure.

The possibility of health effects depends on the gestational age of the unborn baby at the time of exposure and the amount of radiation it is exposed to. Unborn babies are less sensitive to radiation during some stages of pregnancy than others. Unborn babies are particularly sensitive to radiation during their early development, between weeks 2 and 15 of pregnancy. However, since the baby is shielded by the mother's abdomen, the radiation dose to the unborn baby is lower than the dose to the mother for most radiation exposure events.

A pregnant woman who accidentally swallows or breathes in radioactive materials may absorb that substance into her bloodstream. From the mother's blood, radioactive materials may pass through the umbilical cord to the baby or concentrate in areas of the mother's body near the womb (such as the bladder) and expose the unborn baby to radiation.

Unborn babies are especially sensitive to the cancer-causing effects of radiation. However, the increased risks depend on the amount of radiation to which the baby was exposed and the amount of time that it was exposed. For example, if the radiation dose to the unborn baby was roughly equivalent to 500 chest x-rays at one time, the increase in lifetime cancer risk would be less than 2%[2] (above the normal lifetime cancer risk of 40-50%).

During the first 2 weeks of gestation the baby is made up of only a few cells. Damage caused to one of these cells can have a greater impact at this delicate stage than during later stages of gestation when the baby has more cells and damage to one cell is not such a large fraction of the baby's body. Damage to one of only a few cells can lead to the death of the baby before the mother even knows she is pregnant. "Of the babies that survive, however, few will have birth defects related to the exposure, regardless of how much radiation they were exposed to."[3]

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[1] The National Council on Radiation Protection and Measurement recommended in NCRP Report No. 91 "Recommendations on Limits for Exposure to Ionizing Radiation" (June 1, 1987) that no more than 0.05 rem (0.5 millisievert) to the embryo/fetus be received in any one month.
[2] Excerpt from Centers for Disease Control web site article "Possible Health Effects of Radiation Exposure on Unborn Babies".
[3] Excerpt from Centers for Disease Control web site article "Possible Health Effects of Radiation Exposure on Unborn Babies".

Higher radiation doses (doses greater than that received from 500 chest x-rays) during sensitive stages of development, between weeks 2 and 15, can cause birth defects. The brain is particularly sensitive during this stage of development and brain damage may occur.

During the later stages of development, weeks 16-25, effects from low doses of radiation exposure are unlikely. Higher doses of radiation would be required to cause birth defects, but the doses would have to be greater than about 5,000 chest x-rays received at one time.

After the 26th week of gestation, the radiation sensitivity of the unborn baby is similar to that of a newborn baby. At the 26th week of pregnancy, the unborn baby is fully developed though not fully grown. This means that birth defects are not likely to occur, and only a slight increase in the risk of having cancer later in life is expected.

Decisions During Pregnancy

It is your responsibility to decide whether the risks to you or to your unborn child are acceptable. It is up to you to compare the benefits of your employment against the possible risks involving occupational radiation exposure to a known or potential unborn child. You should know that the Pregnancy Discrimination Act, an amendment of Title VII of the Civil Rights Act of 1964, states that "… women affected by pregnancy, childbirth, or related medical conditions; shall be treated the same for all employment-related purposes, including receipt of benefits under fringe benefit programs, as other persons not so affected but similar in their ability or inability to work…." In addition, the Equal Employment Opportunity Commission (a Federal agency) is responsible for examining cases for compliance with this Act. Some facts listed below may be helpful in making this decision.

The first 3 months of pregnancy are the most important, so you should make your decision early.

In most work situations, the actual dose received by an unborn child would be less than the dose you would receive yourself because some of the dose would be absorbed by your body.

The dose to the unborn child can be reduced, where possible, by:

Decreasing the amount of time you spend in an area where you will be exposed to radiation,

Increasing the distance between yourself and the source of radiation, and

Shielding your abdominal area.

If you do become pregnant, you can ask your employer to reassign you to areas involving less exposure to radiation for the duration of your pregnancy.

When your occupational exposure is below the 5 rems per year limit, the risk to an unborn child is small in relation to other day-to-day risks to the unborn child during pregnancy.

There is no need to be concerned about sterility, that is, loss of your ability to bear children. The radiation required to produce this effect is more than 100 times greater than the Nuclear Regulatory Commission's basic dose limits for adults of 5 rems per year.

Questions and Answers

Listed below are some questions and answers excerpted from the Nuclear Regulatory Commission's (NRC) Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure".

Note: Each time the word "licensee" is used in this section consider this to mean the University of Mississippi Medical Center.

1. Why am I receiving this information?

   The NRC's regulations (in 10 CFR 19.12, "Instructions to Workers") require that licensees instruct individuals working with licensed radioactive materials in radiation protection as appropriate for the situation. The instruction below describes information that occupational workers and their supervisors should know about the radiation exposure of the embryo/fetus of pregnant women. The regulations allow a pregnant woman to decide whether she wants to formally declare her pregnancy to take advantage of lower dose limits for the embryo/fetus. This instruction provides information to help women make an informed decision whether to declare a pregnancy.

2. If I become pregnant, am I required to declare my pregnancy?

   No. The choice whether to declare your pregnancy is completely voluntary. If you choose to declare your pregnancy, you must do so in writing and a lower radiation dose limit will apply to your embryo/fetus. If you choose not to declare your pregnancy, you and your embryo/fetus will continue to be subject to the same radiation dose limits that apply to other occupational workers.

3. If I declare my pregnancy in writing, what happens?

   If you choose to declare your pregnancy in writing, the licensee must take measures to limit the dose to your embryo/fetus to 0.5 rem (5 millisievert) during the entire pregnancy. This is one-tenth of the dose that an occupational worker is allowed receive in a year. If you have already received a dose exceeding 0.5 rem (5 mSv) in the period between conception and the declaration of your pregnancy, an additional dose of 0.05 rem (0.5 mSv) is allowed during the remainder of the pregnancy. In addition, 10 CFR 20.1208, "Dose to an Embryo/Fetus," requires licensees to make efforts to avoid substantial variation above a uniform monthly dose rate so that all the 0.5 rem (5 mSv) allowed dose does not occur in a short period during the pregnancy. This may mean that, if you declare your pregnancy, the licensee may not permit you to do some of your normal job functions if those functions would have allowed you to receive more than 0.5 rem, and you may not be able to have some emergency response responsibilities.

4. Why do the regulations have a lower dose limit for the embryo/fetus of a declared pregnant woman than for a pregnant worker who has not declared?

   A lower dose limit for the embryo/fetus of a declared pregnant woman is based on a consideration of greater sensitivity to radiation of the embryo/fetus and the involuntary nature of the exposure. Several scientific advisory groups have recommended that the dose to the embryo/fetus be limited to a fraction of the occupational dose limit.

5. What are the potentially harmful effects of radiation exposure to my embryo/fetus?

   The occurrence and severity of health effects caused by ionizing radiation are dependent upon the type and total dose of radiation received, as well as the time period over which the exposure was received. Refer to Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Exposure" (on file in the UMMC Radiation Safety Office), for more information. The main concern is embryo/fetal susceptibility to the harmful effects of radiation such as cancer.

6. Are there any risks of genetic defects?

   Although radiation injury has been induced experimentally in rodents and insects, and in the experiments was transmitted and became manifest as hereditary disorders in their offspring, radiation has not been identified as a cause of such effect in humans. Therefore, the risk of genetic effects attributable to radiation exposure is speculative. For example, no genetic effects have been documented in any of the Japanese atomic bomb survivors, their children, or their grandchildren.

7. What if I decide that I do not want any radiation exposure at all during my pregnancy?

   You may ask your employer for a job that does not involve any exposure at all to occupational radiation dose, but your employer is not obligated to provide you with a job involving no radiation exposure. Even if you receive no occupational exposure at all, your embryo/fetus will receive some radiation dose (on average 75 mrem (0.75 mSv)) during your pregnancy from natural background radiation. The NRC has reviewed the available scientific literature and concluded that the 0.5 rem (5 mSv) limit provides an adequate margin of protection for the embryo/fetus. This dose limit reflects the desire to limit the total lifetime risk of leukemia and other cancers. If this dose limit is exceeded, the total lifetime risk of cancer to the embryo/fetus may increase incrementally. However, the decision on what level of risk to accept is yours.

8. What effect will formally declaring my pregnancy have on my job status?

   Only the licensee can tell you what effect a written declaration of pregnancy will have on your job status. As part of your radiation safety training, the licensee will tell you the company's policies with respect to the job status of declared pregnant women. In addition, before you declare your pregnancy, you may want to talk to your supervisor or your radiation safety office and ask what a declaration of

pregnancy would mean specifically for you and your job status. In many cases you can continue in your present job with no change and still meet the dose limit for the embryo/fetus. For example, most commercial power reactor workers (approximately 93%) receive, in 12 months, occupational radiation doses that are less than 0.5 rem (5 mSv) (Ref. 11). The licensee may also consider the likelihood of increased radiation exposures from accidents and abnormal events before making a decision to allow you to continue in your present job. If your current work might cause the dose to your embryo/fetus to exceed 0.5 rem (5 mSv), the licensee has various options. It is possible that the licensee can and will make a reasonable accommodation that will allow you to continue performing your current job, for example, by having another qualified employee do a small part of the job that accounts for some of your radiation exposure.

9. What information must I provide in my written declaration of pregnancy?

   You must provide, in writing, your name, a declaration that you are pregnant, the estimated date of conception (only the month and year need be given), and the date that you give the letter to the licensee. A Declaration of Pregnancy form letter that you can use is included in the UMMC Radiation Safety Manual. You may use that letter or write your own letter.

10. To declare my pregnancy, do I have to have documented medical proof that I am pregnant?

    NRC regulations do not require that you provide medical proof of your pregnancy. However, NRC regulations do not preclude the licensee from requesting medical documentation of your pregnancy, especially if a change in your duties is necessary in order to comply with the 0.5 rem (5 mSv) dose limit.

11. Can I tell the licensee orally rather than in writing that I am pregnant?

    No. The regulations require that the declaration must be in writing.

12. If I have not declared my pregnancy in writing, but the licensee suspects that I am pregnant, do the lower dose limits apply?

    No. The lower dose limits for pregnant women apply only if you have declared your pregnancy in writing. The United States Supreme Court has ruled (in *United Automobile Workers International Union v. Johnson Controls, Inc.*, 1991) that "Decisions about the welfare of future children must be left to the parents who conceive, bear, support, and raise them rather than to the employers who hire those parents". The Supreme Court also ruled that your employer may not restrict you from a specific job "because of concerns about the next generation." Thus, the lower limits apply only if you choose to declare your pregnancy in writing.

13. If I am planning to become pregnant but am not yet pregnant and I inform the licensee of that in writing, do the lower dose limits apply?

No. The requirement for lower limits applies only if you declare in writing that you are already pregnant.

14. What if I have a miscarriage or find out that I am not pregnant?

    If you have declared your pregnancy in writing, you must promptly inform the licensee in writing that you are no longer pregnant. However, if you have not formally declared your pregnancy in writing, you need not inform the licensee of your non-pregnant status.

15. How long is the lower dose limit in effect?

    The dose to the embryo/fetus must be limited until you withdraw your declaration in writing or you inform the licensee in writing that you are no longer pregnant. If the declaration is not withdrawn, the written declaration may be considered expired one year after submission.

16. If I have declared my pregnancy in writing, can I revoke my declaration of pregnancy even if I am still pregnant?

    Yes, you may. The choice is entirely yours. If you revoke your declaration of pregnancy, the lower dose limit for the embryo/fetus no longer applies.

17. What if I work under contract at a licensed facility?

    The regulations state that you should formally declare your pregnancy to the licensee in writing. The licensee has the responsibility to limit the dose to the embryo/fetus.

18. Where can I get additional information?

    The Radiation Safety Office can provide more information on request. NRC's Regulatory Guide 8.29, "Instruction Concerning Risks from Occupational Radiation Exposure," and NRC's Regulatory Guide 8.13, "Instruction Concerning Prenatal Radiation Exposure" is on file and can be copied for you.

APPENDIX B

UMMC ALARA Program

UMMC ALARA PROGRAM

The radiation safety program at UMMC will be conducted in such a manner that exposure to faculty, staff, students, visitors, patients not receiving radiation treatments or therapies, the public and the environment will be **A**s **L**ow **A**s **R**easonably **A**chievable. Our ALARA program depends on the cooperation of the Radiation Safety Committee, the Radiation Safety Office, Institutional Management, and all users of ionizing radiation. The ALARA program complies with the requirements of federal and state regulations.

Duties of Management and Workers

The Radiation Safety Manual clearly defines the duties of management and workers. The Radiation Safety Manual can be located on the Environmental Health and Safety site on the UMMC Intranet. Interdepartmental programs define more job specific duties as necessary. It is the responsibility of departmental supervisors or management to insure this document is available and reviewed by employees.

Management Commitment

1. The management and administration of University of Mississippi Medical Center (UMMC throughout the rest of this document) is committed to the program described herein for keeping individual and collective doses as low as is reasonably achievable (ALARA). In accord with this commitment, we hereby describe an administrative organization for radiation safety and will develop the necessary written policy, procedures, and instructions to foster the ALARA concept within our institution. The organization will include a Radiation Safety Committee (RSC), appointed by the Vice Chancellor, and a Radiation Safety Officer (RSO), hired through the Department of Environmental Health and Safety.

2. A formal annual review of the radiation safety program, including ALARA considerations, will be performed and reported to administration through the RSC. This will include reviews of operating procedures and past dose records, inspections, etc., and consultations with the radiation safety staff or outside consultants.

3. Modifications to operating and maintenance procedures and to equipment and facilities will be made if they will reduce exposures unless the cost, in our judgment, is considered to be unjustified. We will be able to demonstrate, if necessary, that improvements have been sought, that modifications have been considered, and that they have been implemented when reasonable. If modifications have been recommended but not implemented, we will be prepared to describe the reasons for not implementing them.

4. In addition to maintaining doses to individuals as far below the limits as is reasonably achievable, the sum of the doses received by all exposed individuals will also be maintained at the lowest practicable level. Due to the nature of the specialties within which UMMC personnel are branched into, certain groups are

expected to receive higher exposures than other groups. Efforts will be made to keep exposures to these specialty areas to the lowest possible level.

Radiation Safety Committee

1. Review of Proposed Users and Uses

    a. The RSC will thoroughly review the qualifications of each applicant with respect to the types and quantities of materials and methods of use for which application has been made to ensure that the applicant will be able to take appropriate measures to maintain exposure ALARA.

    b. When considering a new use of radioactive material, the RSC will review the efforts of the applicant to maintain exposure ALARA.

    c. The RSC will ensure that the users justify their procedures and that individual and collective doses will be ALARA.

2. Delegation of Authority

    The judicious delegation of RSC authority is essential to the enforcement of an ALARA program. This authority is assigned by the Vice Chancellor and will be re-enforced by the Vice Chancellor.

    a. The RSC will delegate authority to the RSO for enforcement of the ALARA concept.

    b. The RSC will support the RSO when it is necessary for the RSO to assert authority. If the RSC has overruled the RSO, it will record the basis for its action in the minutes of the next RSC meeting.

3. Review of ALARA Program

    a. The RSC will encourage all users to review current procedures and develop new procedures as appropriate to implement the ALARA concept.

    b. The RSC will perform a review of occupational radiation exposure with particular attention to instances in which the investigational levels are exceeded. The principal purpose of this review is to assess trends in occupational exposure as an index of the ALARA program quality and to decide if action is warranted when investigational levels are exceeded. (Refer to the Personnel Monitoring section of this document for clarification of investigational levels.)

    c. The RSC will evaluate our institution’s overall efforts for maintaining doses ALARA on an annual basis. This review will include the efforts of the Radiation Safety Office, authorized users, and workers as well as those of management.

Radiation Safety Office

1. Periodic Review of ALARA Program

    a. The Radiation Safety Office will perform an annual review of the radiation safety program for adherence to ALARA concepts. Review of specific methods of use may be conducted on a more frequent basis.

    b. Occupational exposures will be reviewed as the reports are received from the vendor. The Radiation Safety Office will review the external radiation doses of authorized users and workers to determine that their doses are ALARA in accordance with the provisions of this program and will prepare a summary report for the RSC.

    c. Quarterly the Radiation Safety Office will review radiation surveys in unrestricted and restricted areas to determine that dose rates and amounts of contamination were at ALARA levels during the previous quarter.

2. Education Responsibilities for ALARA Program

    a. The Radiation Safety Office will provide training sessions to inform workers of ALARA program efforts.

    b. The Radiation Safety Office will ensure that authorized users, workers, and ancillary personnel who may be exposed to radiation will be instructed in the ALARA philosophy.

3. Cooperative Efforts for Development of ALARA Procedures

    Radiation workers will be given opportunities to participate in formulating the procedures that they will be required to follow.

    a. The Radiation Safety Office will be in close contact with all users and workers in order to develop ALARA procedures for working with radioactive materials.

    b. The Radiation Safety Office will consider the suggestions of individual workers for improving ALARA practices in their respective areas.

4. Reviewing Instances of Deviation from Good ALARA Practices

    The Radiation Safety Office will investigate all known instances of deviation from good ALARA practices and, if possible, will determine the causes. When the cause is known, the Radiation Safety Office will implement changes in the program to maintain doses ALARA.

Authorized Users

1. New Methods of Use Involving Potential Radiation Doses

a. The authorized user will consult with the Radiation Safety Office and/or RSC during the planning stage before using radioactive materials for new uses.

b. The authorized user will review each planned use of radioactive materials to ensure that doses will be kept ALARA.

2. Authorized User's Responsibility to Supervised Individuals

a. The authorized user will explain the ALARA concept and the need to maintain exposures ALARA to all supervised individuals.

b. The authorized user will ensure that supervised individuals who are subject to occupational radiation exposure are trained and educated in good health physics practices and in maintaining exposures ALARA.

Individuals Who Receive Occupational Radiation Doses

1. Workers will be instructed in the ALARA concept and its relationship to work procedures and work conditions.

2. Workers will be instructed in recourses available if they feel that ALARA is not being promoted on the job.

Establishment of Investigational Levels

This institution hereby establishes investigational levels for occupational radiation doses which, when exceeded, will initiate review or investigation by the RSC and/or the Radiation Safety Office. The investigational levels that we have adopted are listed below in the Personnel Monitoring section of this document.

Personnel Monitoring

Personnel will be issued radiation monitoring badges if exposure to radiation is likely to exceed 10% of the maximum permissible dose as stated in state and federal regulations. Annual limits of exposure to radiation are stated in the "Regulations for the Control of Radiation in Mississippi" and are listed below:

1. Occupational Dose Limits for Adults

a. Annual limit shall not exceed which is the more limiting of:

(1). The total effective dose equivalent (TEDE) being equal to 5 rems (5000 mrem or 0.05 sievert); or

(2). The sum of the deep dose equivalent (DDE) and the committed dose equivalent (CDE) to any individual organ or tissue other than the lens of the eye being equal to 50 rems (50000 mrem or 0.5 sievert).

b. Annual limits to the lens of the eye, to the skin, and to the extremities, which are:

(1). A lens dose equivalent (LDE) of 15 rems (15000 mrem or 0.15 sievert), and

(2). A shallow dose equivalent (SDE) of 50 rems (50000 mrem or 0.5 sievert) to the skin or to any extremity.

2. Occupational Dose Limits for Minors

Occupational dose limits for minors are 10 percent of the annual occupational dose limits specified for adult workers.

3. Dose to an Embryo/Fetus

The dose equivalent to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman shall not exceed 0.5 rem (500 mrem or 5 millisieverts).

The dose equivalent to an embryo/fetus shall be taken as the sum of:

a. The deep dose equivalent to the declared pregnant woman; and

b. The dose equivalent to the embryo/fetus from radionuclides in the embryo/fetus itself and radionuclides in the declared pregnant woman.

Dose Limits for Individual Members of the Public

The total effective dose equivalent to individual members of the public from the licensed or registered operation shall not exceed 0.1 rem (100 mrem or 1 millisievert) in a year.

Investigational Levels

The vendor producing and analyzing the monitoring badges provides exposure reports monthly or bi-monthly, determined by the frequency of the badges. These reports are reviewed very closely by the Radiation Safety Office and a copy is provided to each department for personnel review. Unusual exposures and/or errors are noted on the copy of the report maintained within the Radiation Safety Office. As a backup for the review an email is generated by the vendor notifying the Radiation Safety Office of any exposures greater than 400 mrem on any one badge (approximately 1/12 of the yearly exposure limit).

ALARA Level I: Exposures of <u>less than</u> 400 mrem DDE, 1200 mrem LDE, 40 mrem fetal, 4000 mrem SDE, and 4000 mrem extremity, requires no action.

ALARA Level II: Exposures of <u>greater than or equal to</u> 400 mrem DDE, 1200 mrem LDE, 40 mrem fetal, 4000 mrem SDE, and 4000 mrem extremity, requires a review of the exposure report and evaluation of previously recorded exposures, notification of the badge wearer and the badge wearer's supervisor in writing, and a request that a review of workload and procedures be made. Further preemptive investigation may be performed by the Radiation Safety Office on a case by case basis. All Level II exposures will be presented in the next RSC meeting for review.

ALARA Level III: Cumulative exposures during the current calendar year greater than or equal to half the annual occupational limits; 2500 mrem DDE, 7200 mrem LDE, 25000 mrem SDE and 25000 mrem extremity, requires an investigation to be performed by the Radiation Safety Office to determine if the individual is likely to exceed the annual exposure limits. If the individual's exposure has potential to exceed annual regulatory limits, the investigation will be brought to the attention of the RSC and corrective actions will be taken to reduce the individual's exposure.

Cumulative fetal exposure during the gestational period that is greater than or equal to 250 mrem may require an investigation to be performed by the Radiation Safety Office. If necessary, provisions will be taken to ensure that the fetal exposure will not exceed 500 mrem.

If it is determined that medical consult is needed, the individual will be referred to Student/Employee Health.

Principles of Radiation Protection

Employees can maintain ALARA exposures by practicing the basic principles of radiation protection.

1. External Radiation Protection

   a. **Minimize time of exposure:** The less time you remain in a radiation field, the smaller the dose you receive. Perform the procedure or experiment or work with radioactive patients as quickly and as efficiently as possible without increasing the probability of a spill or other accident.

   b. **Maximize the distance from the source:** The dose rate for most gamma and x-ray radiation varies with the inverse square of the distance from a "point" source. Therefore, the farther you position yourself from the source of radiation, the smaller the dose you receive. For example, doubling the distance from a radiation source will result in ¼ the exposure in the same amount of time. Using remote controls on x-ray devices; remote handling devices such as forceps, tongs, and tube racks; standing across the room from a patient when direct contact is not needed; etc. will help minimize exposures to radiation. Even a small increase in distance can result in a dramatic decrease in dose rate.

   c. **Shield the source of radiation:** Place shielding between yourself and a source of penetrating radiation to decrease your dose. For Low energy beta emitters: (such as ^{3}H, ^{14}C, ^{33}P, and ^{35}S) shielding is not necessary. For high energy beta emitters (^{32}P, ^{90}Y), acrylic is the shielding material of choice. For gamma or x-ray emitters (^{51}Cr, ^{125}I, ^{46}Sc, isotopes used for nuclear medicine, etc.) lead is used when exposure rates are significant.

2. Internal Exposure Protection

To ensure that internal exposures are ALARA, engineering and procedural controls will be utilized to prevent introduction of radioactive materials into the body through inhalation, puncture, ingestion, and absorption.

a. **Inhalation:** A chemical fume hood, which has been certified for radioactive materials work, is highly recommended when using potentially volatile compounds. Certain equipment is capable of generating radioactive aerosols. Use centrifuges, vortex mixers, shakers and chromatography plate scraping procedures, etc. in such a way that production of and exposure to radioactive aerosols is minimized.

b. **Puncture:** Dispose of syringes and pipettes promptly and in appropriate containers. Guard against glass breakage and puncture injury during use and disposal. Do not attempt to recap needles before disposal.

c. **Ingestion:** Never introduce any food or drink intended for human consumption into a posted restricted area, even for temporary storage. DO NOT eat or drink in any area where radionuclides are used, never pipette by mouth, and never store food and drinks in a cold room or refrigerator that is designated for radioactive material storage.

d. **Absorption:** Use measures that prevent the contamination of skin and eyes. If there is any possibility that the clothes have been contaminated, remove this clothing before leaving the lab. Eye protection, (e.g. goggles, face shield) is encouraged to prevent contamination of the eyes. This is particularly important for individuals wearing contact lenses since some lenses will absorb and concentrate radiochemicals. Wear protective gloves at all times when working with radioactive materials. Change gloves frequently during the work, disposing of the used gloves as radioactive waste. Wash hands after using radioactive materials and monitor the hands for contamination prior to leaving the laboratory, and especially before eating or smoking.

Signature of Certifying Officials

I hereby certify that UMMC has implemented the ALARA Program described above.

James E. Keeton, M.D

Vice Chancellor for Health Affairs and Dean, School of Medicine

Signature_____ Date_____

Martin H. McMullan, M.D.

Radiation Safety Committee Chair

Signature_____ Date_____

Robert B. Nelson, RSO

Radiation Safety Officer

Signature_____ Date_____

APPENDIX C

Nuclear Medicine Quality Management Program

University of Mississippi Medical Center / Cancer Institute

Nuclear Medicine/ Nuclear Cardiology/ PET/CT

QUALITY MANAGEMENT PROGRAM

For Administration of Therapeutic Doses of Radiopharmaceuticals and Doses in Excess of 30 Microcuries of Sodium Iodide (NaI) I-131

A. **OBJECTIVE:** The objective of this Quality Management Program (QMP) is to provide high confidence that radioactive material or radiation from radioactive material will be administered as directed by the authorized user and thereby eliminate misadministrations.

B. **AUTHORITY AND RESPONSIBILITY:** The authority and responsibility to establish and implement this Quality Management Program shall be given to the Nuclear Medicine/ Nuclear Cardiology/ and PET/CT Departments and the Radiation Safety Office. Directives contained herein are added to the existing Department Procedures and the facility ALARA Program.

C. **POLICY:** This policy is for the administration of radiopharmaceutical therapies and sodium iodide (NaI) I-131 in amounts greater than 30 microcuries at UMMC.

A written directive means an authorized user's written order for the administration of radioactive material or radiation from radioactive material to a specific patient or human research subject.

1. A written directive must be dated and signed by an authorized user **prior** to administration of I-131 sodium iodide greater than 30 uCi or any therapeutic dosage of radioactive material or any therapeutic dose of radiation from radioactive material.

2. The written directive must contain the patient's name, the pharmaceutical, isotope, dosage, and route of administration.

   Note: The above mentioned information is recorded on the patient requisition and in the formal report completed by the authorized user caring for this patient.

3. Except in emergency situations, no radiopharmaceutical shall be administered by any personnel in the absence of a signed written directive containing the above elements.

4. A written revision to an existing written directive may be made provided that the revision is dated and signed by an authorized user prior to the administration of the dosage of radiopharmaceutical.

5. If, because of the emergent nature of the patient's condition, a delay in order to provide a *written directive* would jeopardize the patient's health,

an oral directive shall be acceptable, provided that the information contained in the oral directive is documented as soon as possible in the patient's record and a written directive is prepared and signed by the authorized user within 48 hours of the oral directive.

6. If, because of the patient's condition, a delay in order to provide a *written revision to an existing written directive* would jeopardize the patient's health, an oral revision to an existing written directive shall be acceptable, provided that the oral revision is documented as soon as possible in the patient's record and a revised written directive is signed by the authorized user within 48 hours of the oral revision.

7. Specific details of the administration must be in accordance with the written directive.

8. Both manual and computer generated dose calculations must be checked for accuracy.

9. Any unintended deviation from the written directive shall be identified and evaluated so that appropriate action can be taken. The Radiation Safety Office will be notified of the deviation.

10. Records of the written directives shall be retained for a period of three (3) years.

11. Prior to administration of I-131 sodium iodide greater than 30uCi or a radiopharmaceutical therapy, the patient's identity shall be verified by more than one method as the patient named in the written directive. The person responsible for administering the radiation will complete the verification by at least two of the following methods:

    a. Asking the patient to state his/her name,

    b. Comparing patient to a recent photograph of same,

    c. Asking the patient to state his/her birth date,

    d. Asking the patient to state his/her Social Security Number,

    e. Asking the patient to state his/her address,

    f. Asking the patient for identification such as a driver's license, Social Security card, or similar,

    g. Checking the patient's wrist identification band for name, birth date, or UMMC ID number, or

    h. For patients unable to respond, an accompanying relative or friend may attest to the identity.

Documentation of the verification of the patient's identity shall include the two (2) forms with which the patient was identified, the date of the identification, and the name of the person making the identification. This record will be maintained for three (3) years. The determination of which two identifiers to use shall be based on departmental policy that complies with all regulatory entities applicable to the nuclear medicine treatment programs.

If the information obtained from any two of these methods does not correspond to the information on the written directive, the radiation dose **SHALL NOT** be administered until conclusive verification of the patient's identity is obtained.

12. A Nuclear Medicine/ Nuclear Cardiology/ PET/CT technologist shall read the written directive before preparing or administering the radiopharmaceutical. If any portion of the written directive is unclear, he/she must contact the specific authorized user who provided the written directive for clarification.

    a. The radiopharmaceutical shall not be administered until the intent of the written directive is thoroughly understood by the technologist. If the person preparing the dose is different from the person administering the dose, both shall read and understand the written directive.

    b. The technologist shall verify that the specific details of the administration (i.e. radiopharmaceutical, dose, route of administration) are in accordance with the written directive. The actual dose calibrator assay shall be verified with the dosage listed on the written directive. In the case of pure beta-emitting radiopharmaceuticals, calculation of the dosage amount shall be based on the manufacturer's assay calibration and verified by the administering personnel.

13. Following the administration of the radiopharmaceutical dose, a dated and signed note is entered into the patient's record documenting the administration and dosage. Any therapeutic administration must be recorded into the patient's permanent medical record. These records must be retained for at least three (3) years.

14. Department Procedures shall contain protocols for all radiopharmaceutical procedures which require written directives and be available for review. Nuclear Medicine/ Nuclear Cardiology/ PET/CT technologists shall be familiar with the contents of these procedures. Technologists shall be instructed to refer to the Department Procedures before proceeding with any non-routine procedure or in any case in which the protocol is not completely familiar to them.

The Chief of Nuclear Medicine shall approve any change in protocol before that change is implemented and always before the change is incorporated into the procedure manual. Each technologist shall be instructed in the change before it is implemented or incorporated into the procedure manual.

15. If a deviation from the written directive is identified, such as a misadministration, an investigation of the incident shall be made. Documenting and reporting of the deviation shall be in accordance with the reporting requirements of the “Regulations for Control of Radiation in Mississippi”.

Misadministration: The Radiation Safety Office shall be contacted immediately upon determination that a misadministration has occurred.

The MS State Department of Health/Division of Radiological Health (MSDH/DRH) shall be notified by telephone no later than the next calendar day after discovery of the misadministration.

The written report shall include: the university's name and department; the prescribing physician's name; a brief description of the event; why the event occurred; the effect on the patient; the actions taken or planned to prevent recurrence; certification that UMMC has notified the patient or the patient's responsible relative or guardian, and if not, why not, and what information was provided to the patient. The report may **not** include the patient's name or other information that could lead to identification of the patient.

The authorized user shall provide notification of the misadministration to the referring physician and also notify the patient or a responsible relative or guardian no later than 24 hours after its discovery, unless the referring physician personally informs the authorized user either that he or she will inform the patient or that, based on medical judgment, telling the patient would be harmful. The authorized user is not required to notify the patient without first consulting with the referring physician. If the referring physician or the patient cannot be reached within 24 hours, they shall notify the patient as soon as possible thereafter. Nuclear Medicine/ Nuclear Cardiology/ PET/CT Departments may not delay any appropriate medical care for the patient, including any necessary remedial care as a result of the misadministration, because of any delay in notification.

If the patient was notified, a written report will be furnished to the patient, within 15 days after discovery of the misadministration. The report will either be a copy of the report that was submitted to MSDH, or a brief description of both the event and the consequences as they may affect the patient. If a letter describing the event and the consequences, not the report submitted to MSDH, is sent to the patient, it will include a statement to the effect that a copy of the report submitted to MSDH will

be made available to the patient if requested. A copy of this report shall be provided to the referring physician within 15 days after discovery of the misadministration.

The Nuclear Medicine/ Nuclear Cardiology/ PET/CT Departments shall retain a record of each misadministration for three (3) years. The record must contain: the university's name and department; the names of all individuals involved including the prescribing physician, allied health personnel, the patient, and the patient's referring physician; the patient's Social Security Number or medical record number; a brief description of the event; why it occurred; the effect on the patient; the actions taken or planned to prevent recurrence; whether the authorized user notified the patient or their responsible relative or guardian and if not, whether such failure to notify was based on the guidance from the referring physician.

D. ANNUAL REVIEW: There shall be an annual review of the Quality Management Program to determine its effectiveness.

1. The review will include, from the previous 12 months, a randomly selected representative sample of patient administrations and all misadministrations.

    a. For each patient case reviewed, a comparison shall be made between what was prescribed in the written directive and what was actually administered. It shall be determined whether the administered radiation dose was in accordance with the written directive in terms of treatment site, procedure, isotope, fractional dose or total dosage.

    b. For each patient case reviewed, any deviations from the written directive shall be identified along with the cause of each, if possible, and the action taken to prevent recurrence.

    c. When a misadministration is uncovered during the periodic review of the QMP, the number of cases included in the review will be expanded.

2. The records of each review will be retained for three (3) years. These records shall be available for inspection by the MSDH/DRH. The results of the annual review will also be distributed to appropriate management officials.

3. Following the annual review the Radiation Safety Committee will determine if the policies and procedures of the Quality Management Program are effective or require modification. Any modifications in the QMP will be submitted to the MSDH/DRH within 30 days after the modifications have been made.

E. **IMPLEMENTATION:** The policies and procedures specified in this revised document will be implemented upon approval by the Radiation Safety Committee.

_____ _____

Chair, Radiation Safety Committee Date

_____ _____

Chief of Nuclear Medicine Date

_____ _____

Radiation Safety Office Date

Reporting Requirements for Nuclear Medicine/ Nuclear Cardiology/ PET/CT

Misadministration

1. Other than events that result from intervention by a patient, Nuclear Medicine/ Nuclear Cardiology/ PET/CT shall report any event in which the administration of a radiopharmaceutical results in:

    a. A dose that differs from the prescribed dose by more than 5 Rem effective dose equivalent, 50 Rem to an organ or tissue, or 50 Rem shallow dose equivalent to the skin; and the total dosage delivered differs from the prescribed dosage by 20 percent or more or falls outside the prescribed dosage range.

    b. A dose that exceeds 5 Rem effective dose equivalent, 50 Rem to an organ or tissue, or 50 Rem shallow dose equivalent to the skin from any of the following:

        (1) An administration of a wrong radiopharmaceutical;

        (2) An administration of a radiopharmaceutical by the wrong route of administration;

        (3) An administration of a dosage to the wrong individual;

        (4) An administration of a dosage delivered by the wrong mode of treatment; or

        (5) A leaking sealed source.

    c. A dose to the skin or an organ or tissue other than the treatment site that exceeds by 50 Rem to an organ or tissue and 50 percent of the dose expected from the administration defined in the written directive.

2. Nuclear Medicine/ Nuclear Cardiology/ PET/CT shall report any event resulting from intervention of a patient in which the administration of radioactive material results, or will result in, unintended permanent functional damage to an organ or a physiological system, as determined by a physician.

APPENDIX D

Nursing Instructions for I-131 Therapy

INSTRUCTIONS TO NURSES ASSIGNED TO PATIENTS RECEIVING THERAPEUTIC RADIOPHARMACEUTICALS

1. Personnel involved in direct care must wear a digital dosimeter provided by the Radiation Safety Office.

    a. Before entering the patient's room, the attendant will turn on the dosimeter and clip the dosimeter to the uniform pocket.

    b. Upon leaving the patient's room, return the dosimeter to the nursing station. The attendant will press the LED button and read the numbers on the lighted display window. Exposure will be displayed in mR.

    c. The attendant will use the exposure log to record date, name, dosimeter and reading before turning off the dosimeter.

    d. If the dosimeter alarm sounds, there is no reason for concern. This alarm signifies that it is time to complete your tasks in the patient's room. <u>This is not an indication of harmful exposure.</u> Silence the alarm by pressing the LED button and reading the mR display. Upon leaving the room, press the LED button and read the mR display again for the exposure log record.

    e. The dosimeter and exposure log will be picked up by the Radiation Safety Office at the conclusion of the patient's treatment. Exposure records will be maintained by the Radiation Safety Office.

    f. Nurses must spend only that amount of time near the patient required for essential nursing care. Call the Radiation Safety Office with any question about the care of these patients (Ext. 41980).

2. Visitors will be limited to those 18 years of age or over unless other instructions are given by the Radiation Safety Office.

3. A boundary line will be marked on the floor at the entrance to the patient's room. Visitors will be instructed to remain behind the boundary line. The patient will be instructed to remain in bed when visitors are present and to ask visitors to move out of the room momentarily if the patient must move away from the bed. The patient's room will be surveyed twice per day by the Radiation Safety Office. Except for essential services to the patient, employees shall limit their time around the patient's bed.

4. Patients containing radioactive materials are to be confined to their rooms except for special medical or nursing purposes approved by the Radiation Safety Office or in the case of an emergency.

5. Visitors or attendants who are pregnant should not be permitted in the room of a patient who has received a therapeutic amount of radioactivity until the patient no longer presents a radiation hazard. Female visitors should be asked whether they

are pregnant. Declared pregnant nurses should not be assigned to the personal care of these patients.

6. Attending personnel must wear disposable rubber or plastic gloves when handling urinals, bedpans, emesis basins or other containers having any material obtained from the body of the patient. Wash gloves before removing and then wash hands. The gloves must be left in the patient's room in the designated waste container. These gloves need not be sterile or surgical in type.

7. Disposable items must be used in the care of these patients whenever possible. These items must be placed in the designated waste container after use. Contact the Radiation Safety Office for proper disposal of the contents of the designated waste container.

8. All clothes and bed linens used by the patient must be placed in the plastic bag designated for laundry and must be left in the patient's room to be checked by the Radiation Safety Office.

9. All non-disposable items must be left in the patient's room to be checked by the Radiation Safety Office.

10. Surgical dressings should be changed only as directed by the physician. Such dressing must not be discarded as ordinary medical waste but must be deposited in the marked containers in the room and turned over to the Radiation Safety Office. When handling these dressings, wear disposable gloves.

11. For Iodine-131(NaI) patients treated for thyroid carcinoma.

    a. Urine from Iodine-131 patients will be disposed of by release into the sanitary sewer system. If the patient is bedridden, a separate urinal or bedpan must be provided. The urinal or bedpan must be flushed several times with water after use.

    b. If the nurse helps to collect the excreta, disposable gloves must be worn. Afterwards, hands must be washed with the gloves on and again after the gloves are removed. The gloves must be placed in the designated waste container for disposal by the Radiation Safety Office.

    c. Disposable plates, cups, eating utensils, and food trays will be used when possible by patients who are treated with Iodine-131.

    d. Vomiting within 48 hours after oral administration, urinary incontinence or excessive sweating within the first 48 hours may result in contamination of linen and floor. Vomiting can also result in the loss of enough radioactive iodine from the patient to compromise the effectiveness of the entire therapeutic procedure. If any such situation occurs or if radioactive urine and/or feces is spilled during collection, call the Radiation Safety Office. Meanwhile, handle all contaminated material with disposable gloves and

avoid spreading contamination. If contamination of the floor is suspected, shoe covers must be worn.

e. Vomitus may be disposed of in the sanitary sewer. Feces need not be routinely saved, unless ordered on the chart and approved by the Radiation Safety Office. The same toilet must be used by the patient at all times and it must be flushed two times after each use. Male patients shall be instructed to sit down to urinate.

12. Precautions must be taken to see that no urine or vomitus is spilled on the floor or the bed. If such a spill occurs, notify the Radiation Safety Office.

13. If a nurse, attendant, or anyone else knows or suspects that his or her skin or clothing, including shoes, is contaminated, notify the Radiation Safety Office immediately. This person must remain in an area adjacent to the patient's room and must not walk about the hospital. If the hands become contaminated, wash them immediately with soap and warm water.

14. If a therapy patient should need emergency surgery or should die, notify the Radiation Safety Office and the Nuclear Medicine Department immediately.

15. The patient is not to be discharged without first contacting the Radiation Safety Office or the Nuclear Medicine Department.

16. The patient's room shall not be released for use by another patient until it is surveyed and decontaminated by the Radiation Safety Office.

Radiation Safety Office: (601) 984-1980

After Hours and weekends see On-Call Scheduling for Radiation Safety at UMMC Intranet

Emergency Dispatch: (601) 984-1420

APPENDIX E

Instructions for Therapeutic Administration of I-131

THERAPEUTIC USE OF IODINE-131 (NaI)

1. All patients treated with iodine-131(NaI) will be treated in a private room specially equipped with a seamless floor and stainless steel sink and toilet.

2. Prepare the room as follows:

   a. Remove all excess furniture and equipment from the room that will not be needed for the patient.

   b. Use polycoated craft paper to cover floor surfaces, counter tops, tables, bathroom rails, and walls that the patient will be in contact with that are likely to become contaminated. Items such as the telephone, nurse call/TV control, door handles, faucet handle, bed rails, tray table, and toilet may be covered with plastic bags to prevent their contamination. Masking tape may be used to cover light switches, cabinet handles, thermostat controls, and to secure the craft paper and plastic bags.

   c. Patients will be instructed to only touch covered surfaces.

   d. Disposable gloves should be used when handling the patient, contaminated waste, linen, or any items that may have come in contact with the patient's hands, skin, or urine.

   e. Separate plastic bags will be needed for linen, disposable waste, and non-disposable contaminated items. <u>No items will be allowed to leave the room until they have been surveyed and cleared by the Radiation Safety Office.</u>

      (1) All linens will be placed in a plastic bag and surveyed for contamination before being removed from the patient's room and will be held for decay-in-storage.

      (2) Disposable plates, cups, eating utensils, food trays, tissue, and other similar disposable waste items will be placed in a waste can lined with a plastic bag and tagged as "Caution Radioactive Material". This waste will be surveyed for contamination and held for 10 half-lives.

      (3) Non-disposable items such as blood pressure machines and tray tables used for these patients will be held in the patient's room and will be checked for contamination by the Radiation Safety Office. Items may be returned for normal use, held for decay, or decontaminated, as appropriate.

   f. Urine will be discarded by release to the sanitary sewer. The patient will be instructed to flush twice after using the restroom. Urine should not be collected at this time to reduce exposure to the patient and hospital staff.

   g. The patients room will be posted "Caution Radioactive Materials Area" and the foot of the bed will be posted "Caution Radiation Area" after the patient is administered the radiopharmaceutical.

3. Order disposable table service for the duration of the patient's stay.

4. Inform housekeeping staff that personnel should stay out of the room until the Radiation Safety Office has released it.

5. Supply the nurses with personal dosimetry devices, pocket ionization chambers, or an electronic alarming dosimeter and instruct them in the use of these monitoring devices.

   Note: If personal dosimetry devices are provided, they cannot be exchanged between personnel. Each device is assigned to one person to be worn by that person only.

6. Brief the nurses on radiation safety precautions. Use the "Instructions to Nurses Assigned to Patients Receiving Therapeutic Radiopharmaceuticals" guidelines. Allow time for questions and answers during the briefing. Leave a written copy of the radiation safety precautions at the nurses' station.

7. Brief the patient on radiation safety procedures for the dosage administration, visitor control, radioactive waste, and other items as applicable for their stay at the hospital and when they are released.

8. Only those persons needed for medical, safety, or training purposes should be present during the administration.

9. Surveys of the patient's room and surrounding areas will be conducted as soon as practicable after administration of the treatment dose. Exposure rates will be measured at the patient's bedside, at one (1) meter away, and at the entrance to the room. The Radiation Safety Office will then record these readings on the form, "Nursing Instructions for Patients Treated with Iodine-131, Phosphorus-32, or Gold-198", and the form will be posted outside the patient's room immediately after administration of the treatment dose.

10. Visitors will not be allowed inside the patient's room after the administration of the radiopharmaceutical without prior approval and supervision of the Radiation Safety Office.

11. Radiation levels in unrestricted areas will be monitored to ensure the radiation levels do not exceed the exposure limits set in the regulations for individual members of the public.

12. Do not release any patient until either the exposure rate from the patient is less than seven (7) millirem per hour at one (1) meter or the retained radioactivity is less than 33 millicuries. Patients may be released with dose rates greater than 7 millirem per hour at 1 meter and activities greater than 33 millicuries following the guidelines for patient release in NUREG 1556 Vol. 9 Appendix U “Model Procedure for Release of Patients or Human Research Subjects Administered Radioactive Materials”. Records of releases of patients administered radiopharmaceuticals shall be retained for three (3) years.

13. Before a therapy patient's room is reassigned to another patient, the room will be surveyed for contamination and decontaminated if necessary, and all radioactive waste, linen, and contaminated equipment will be removed.

14. In accordance with "The Regulations for Control of Radiation in Mississippi", within six (6) to seventy-two (72) hours after administration of a dose of liquid or gelatin-capsule I-131 to a patient, the thyroid burden of all personnel who helped prepare or administer the dose will be measured. Retain a record of the bioassay for three (3) years. The record will include:

    a. The name of the individual whose thyroid burden was measured;

    b. The measurement;

    c. The date of the measurement; and

    d. The initials of the individual who made the measurements.

APPENDIX F

Radioiodine Bioassay Procedure

RADIOIODINE BIOASSAY PROCEDURE

Multi-Channel Analyzer Calibration

The Ludlum System Acquisition and Analysis Software and a Ludlum model 732 2x2 NaI probe is used to measure the thyroid burden for radioactive iodine. The system will be calibrated annually.

Allow the system to warm up for about 30 minutes before proceeding with the calibration.

A. Region of Interest

The region of interest is set by the software for Iodine-131 and Iodine-125. In the case if I-131, the region of interest is in the area of 364 keV. For I-125, the region of interest is in the area of 35.5 keV.

B. Establish Background

Hold probe next to the phantom (without a source inserted) and initiate a two minute count. Divide the results by 2 to get counts per minute (cpm). Record results.

C. Count Standard

A known (measured) amount of radioactivity must be used as the standard. When assaying for I-131, an I-131 standard (or a standard source of known activity that emits photons of approximately the same energy as I-131. e.g., Barium-133) must be used. I-131 liquid or capsule may be used, and must be measured and corrected for decay. When assaying for I-125, an I-129 source may be used. Sealed sources shall be decayed from the original assay to determine the activity at the time of calibration.

Place the standard in the Nuclear Associates (Victoreen) standard thyroid uptake neck phantom model 74-365. Hold probe against the phantom in a geometry similar to one to be used when performing a bioassay on an individual. Count the standard for two minutes. Divide the counts by 2 to get the counts per minute. Record results. Repeat the procedure for a total of ten counts. Total the sum of the ten counts and divide by 10 to get an average count per minute.

Ba-133:I-131 Correction Factor: 1.299

Ba-133 – 356 keV gamma ray with 62.05 % abundance

I-131 – 364 keV gamma ray with 80.6 % abundance

I-129:I-125 Correction Factor: 0.754

Multiply the average counts per minute by the Ba-133:I-131 correction factor or the I-129:I-125 correction factor to correct for the difference in % abundance

between the emissions of the two isotopes when using Ba-133 or I-129 sealed sources to calibrate the MCA.

Specifications for design of a neck phantom can be found in American National Standard ANSI N44.3-1973, "Thyroid Radioiodine Uptake Measurements Using a Neck Phantom".

D. Establish System Efficiency

$$\text{Average Standard CPM} - \text{Background CPM} = \text{Net Standard CPM}$$

$$\frac{\text{Net Standard CPM}}{\text{Standard Activity (uCi)}} * \frac{100}{2.2 * 10^6 \text{ DPM/uCi}} = \% \text{ Efficiency}$$

Investigation Limits

A. The **evaluation level** will be 2% of the Annual Limit on Intake (ALI).

ALI for I-131 is 50 uCi inhalation x .02 = 1.0 uCi

ALI for I-125 is 60 uCi inhalation x .02 = 1.2 uCi

Whenever the thyroid burden at the time of measurement exceeds 1.0 microcurie of I-131 or 1.2 microcuries of I-125, the following actions must be taken:

1. Determine the causes of exposure and evaluate the potential for further exposures. If further exposure is expected, it will be necessary to restrict the worker from the area until the problem is corrected.

2. Additional bioassay measurements will be taken to obtain the best estimate of actual intake.

B. The **investigational level** will be 10% of the Annual Limit on Intake (ALI).

ALI for I-131 is 50 uCi inhalation x 0.1 = 5.0 uCi

ALI for I-125 is 60 uCi inhalation x 0.1 = 6.0 uCi

If the thyroid burden at any time exceeds 5.0 microcuries of I-131 or 6.0 microcuries of I-125, the following actions must be taken:

1. Carry out all steps as described in part A. above.

2. If practical, daily measurements shall be made until a pattern of bodily retention and excretion can be established and the thyroid burden is less than 1.0 microcurie of I-131 or 1.2 microcuries of I-125.

3. If a worker receives an intake in excess of the ALI, the regulations prohibit any occupational exposure during the remainder of the year in which the limit is exceeded.

4. For high intake readings refer the case to appropriate medical consultation as soon as possible for recommendations regarding therapeutic procedures that may be carried out to accelerate removal of radioiodine from the body. If possible, this shall be done within 2-3 hours after exposure so that a thyroid-blocking agent would be effective.

Evaluation and investigational levels were taken from Regulatory Guide 8.9 – "Acceptable Concepts, Models, Equations and Assumptions for a Bioassay Program", Revision 1, July 1993.

Measurement

A. Measure Thyroid Gland

1. Perform measurements in a low background area.

2. Perform a background measurement for two minutes and divide the results by 2. Record results.

3. Hold probe in the center of the neck near the Adam's apple for a two minute count and divide the results by 2. Record results.

4. Subtract background counts from thyroid counts to obtain net counts. Record results.

5. Calculate and record the amount of radioactivity in the thyroid by using the following equation:

$$\frac{\text{Net Counts (CPM) X 100}}{\%\ \text{Efficiency X 2.2 x } 10^6\ \text{DPM/uCi}} = \_\_\_\_\_\text{uCi}$$

6. Record the results and compare them to the evaluation and investigational levels.

7. Bioassay records shall include the thyroid burden measurement, date of measurement, the name of the individual whose thyroid burden was measured, and the initials of the individual who made the measurements.

Retain bioassay records for a period of three (3) years.

Appendix G

Dose Calibrator Calibration Procedures

Procedure for Calibrating Dose Calibrator

A. Calibrations

Qualified personnel or the radiopharmacy will perform calibration procedures on dose calibrators.

1. Repair, replacement, or arithmetic correction will be considered if the dose calibrator falls outside of suggested tolerances.

2. Recommended tolerances for UMMC are more restrictive than those in the Regulations for the purpose of ensuring that corrective actions will be taken before the dose calibrator is outside permissible tolerances.

3. Tests will be completed at the indicated frequency noted below.

   a. Constancy checks will be completed at least once each day prior to assay of patient dosages (± 5 percent).

   b. Linearity tests will be completed at installation and at least quarterly thereafter (± 5 percent).

   c. Geometry dependence will be completed at installation (± 5 percent).

   d. Accuracy tests will be completed at installation and at least annually thereafter (± 5 percent).

4. After repair, adjustment, or relocation of the dose calibrator, repeat the Accuracy and Geometrical Variance tests as appropriate.

B. Constancy means reproducibility in measuring a constant source over a long period of time.

1. To perform a constancy check, assay at least one relatively long-lived source such as Cs-137, Co-60, or Co-57 using a reproducible geometry each day before using the calibrator. Consider the use of two or more sources with different photon energies and activities. Use the following procedure:

   a. Assay each reference source using the appropriate dose calibrator setting (i.e., use the Cs-137 setting to assay Cs-137).

   b. Measure background at the same setting, and subtract or confirm the proper operation of the automatic background subtract circuit if it is used.

   c. For the Cs-137 source, record and initial the net activity of the Cs-137 setting. Results must be ± 5% of the present activity.

   d. Repeat the above procedure for all commonly used radioisotope settings. Plot or log the results.

   e. Establish an action level or tolerance for each recorded measurement at which the individual performing the test will automatically notify the chief technician or authorized user of suspected malfunction of the calibrator.

These action levels are set at ± 10% of the recorded values. The regulations require repair or replacement if the error exceeds 10 percent.

2. Inspect the instrument on a quarterly basis to ascertain that the measurement chamber liner is in place and that the instrument is zeroed according to the manufacturer's instructions.

C. Linearity means that the calibrator is able to indicate the correct activity over the range of use of that calibrator.

This test is done using a vial or syringe of Tc-99m whose activity is at least as large as the maximum activity normally assayed in a prepared radiopharmaceutical kit, in a unit dosage syringe, or in a radiopharmaceutical therapy, whichever is largest.

a. Decay Method

1) Assay the Tc-99m syringe or vial in the dose calibrator, and subtract background to obtain the net activity in millicuries. Record the date, the time to the nearest minute, and net activity. This first assay should be done in the morning at a regular time, for example, 8 a.m.

2) Repeat the assay about noon, and again at 4 p.m. Continue on subsequent days until the assayed activity is less than 30 microcuries. For dose calibrators on which you select a range with a switch, select the range you would normally use for the measurement.

3) Convert the time and date information you recorded to hours elapsed since the first assay.

4) On a sheet of log-log graph paper, label the vertical axis in actual millicuries as recorded on the dose calibrator. Label the logarithmic horizontal axis in millicuries as calculated for decay. Plot the actual readings in millicuries against the calculated readings in millicuries. The actual readings versus the calculated activity must be within ± 5%. At the top of the graph note the date, manufacturer, model number, and serial number of the dose calibrator. Then plot the data.

5) Draw a "best fit" straight line through the data points. For the point farthest from the line, calculate its deviation from the value on the line.

Deviation = (activity observed - activity value from "best fit" line) activity value from "best fit" line

6) If the worst deviation is more than ± 0.05, the dose calibrator should be repaired or adjusted. If this cannot be done, it will be necessary to make a correction table or graph that will allow you to convert from activity indicated by the dose calibrator to "true activity".

7) Put a sticker on the dose calibrator that states when the next linearity test is due.

b. Shield Method

If you decide to use a set of "sleeves" of various thicknesses to test for linearity, it will first be necessary to calibrate them.

1) Begin the linearity test as described in the decay method described above. After making the first assay, the sleeves can be calibrated as follows. Steps 2) through 4) below must be completed within 6 minutes.

2) Put the base and sleeve 1 in the dose calibrator with the vial. Record the sleeve number and indicated activity.

3) Remove sleeve 1 and put in sleeve 2. Record the sleeve number and indicated activity.

4) Continue for all sleeves.

5) Complete the decay method linearity test steps 2) through 7) above.

6) From the graph made in step 4) of the decay method, find the decay time associated with the activity indicated with sleeve 1 in place. This is the "equivalent decay time" for sleeve 1. Record that time with the data recorded in step 2).

7) Find the decay time associated with the activity indicated with sleeve 2 in place. This is the "equivalent decay time" for sleeve 2. Record that time with the data recorded in step 3).

8) Continue for all sleeves.

9) The table of sleeve numbers and equivalent decay times constitutes the calibration of the sleeve set.

The sleeve set may now be used to test dose calibrators for linearity.

1) Assay the Tc-99m syringe or vial in the dose calibrator, and subtract background to obtain the net activity in millicuries. Record the net activity.

2) Steps 3) through 5) below must be completed within 6 minutes.

3) Put the base and sleeve 1 in the dose calibrator with the vial. Record the sleeve number and indicated activity.

4) Remove sleeve 1 and put in sleeve 2. Record the sleeve number and indicated activity.

5) Continue for all sleeves.

6) Or on a sheet of semilog graph paper, label the logarithmic vertical axis in millicuries and label the linear horizontal axis in hours elapsed. At the top of the graph, note the date and the model number and serial number of the dose calibrator.

7) Plot the data using the equivalent decay time associated with each sleeve.

8) Draw a "best fit" straight line through the data points. For the point farthest from the line, calculate its deviation from the value on the line.

Deviation =(activity observed - activity value from "best fit" line) activity value from "best fit" line

9) If the worst deviation is more than ±0.05, the dose calibrator should be repaired or adjusted. If this cannot be done, it will be necessary to make a correction table or graph that will allow you to convert from activity indicated by the dose calibrator to "true activity".

10) Put a sticker on the dose calibrator that says when the next linearity test is due.

D. Geometry independence means that the indicated activity does not change with volume or configuration.

1. This test should be done using a syringe that is normally used for injections. Licensees who use generators and radiopharmaceutical kits should also do the test using a vial similar in size, shape, and construction to the radiopharmaceutical kit vials normally used.

2. The following test assumes injections are done with 3-cc plastic syringes and that radiopharmaceutical kits are made in 30-cc glass vials. If you do not use these, change the procedure so that your syringes and vials are tested throughout the range of volumes commonly used.

a. In a small beaker or vial, mix 2 cc of a solution of Tc-99m with an activity concentration between 1 and 10 mCi/ml. Set out a second small beaker or vial with non-radioactive saline. You may also use tap water.

b. Draw 0.5 cc of the Tc-99m solution into the syringe and assay it. Record the volume and millicuries indicated on Form 109 (Dose Calibrator Geometrical Variation Test).

c. Remove the syringe from the calibrator, draw an additional 0.5 cc of non-radioactive saline or tape water, and assay again. Record the volume and millicuries indicated.

d. Repeat the process until you have assayed a 2.0 cc volume.

e. Select as a standard the volume closest to that normally used for injections. For all the other volumes, divide the standard millicuries by the millicuries indicated for each volume. The quotient is a volume correction factor. Alternatively, you may graph the data and draw horizontal 5 percent error lines above and below the chosen "standard volume".

f. If any correction factors are greater than 1.05 or less than 0.95, or if any data points lie outside the 5 percent error lines, it will be necessary to make a correction table or graph that will allow you to convert from "indicated activity" to "true activity". If this is necessary, be sure to label the table or graph "syringe geometry dependence", and note the date of the test and the model number and serial number of the calibrator.

g. To test the geometry dependence for a 30-cc glass vial, draw 1.0 cc of the Tc-99m solution into syringe and then inject it into the vial. Assay the vial. Record the volume and millicuries indicated.

h. Remove the vial from the calibrator and, using a clean syringe, inject 2.0 cc of non-radioactive saline or tap water, and assay again. Record the volume and millicuries indicated.

i. Repeat the process until you have assayed a 19.0 cc volume. The entire process must be completed within 10 minutes.

j. Select as a standard the volume closest to that normally used for mixing radiopharmaceutical kits. For all the other volumes, divide the standard millicuries by the millicuries indicated for each volume. The quotient is a volume correction factor. Alternatively, you may graph the data and draw horizontal 5 percent error lines above and below the chosen "standard volume".

k. If any correction factors are greater than 1.05 or less than 0.95 or if any data points lie outside the 5 percent error lines, it will be necessary to make a correction table or graph that will allow you to convert from "indicated activity" to "true activity". If this is necessary, be sure to label the table or graph "vial geometry dependence", and note the date of the test and the model number and serial number of the calibrator.

1. Accuracy means that, for a given calibrated reference source, the indicated millicurie value is equal to the millicurie value determined by the National Institute of Standards and Technology (NIST) or by the supplier who has compared that source to a source that was calibrated by the NIST.

   Certified sources are available from the NIST and from many radioisotope suppliers.

   1. To complete an accuracy test, at least two sources with different principal photon energies (such as Co-57, Ba-133, or Cs-137) shall be used.

   2. The regulations require that one must have a principle photon energy between 100 keV and 500 keV.

   3. The regulations also require that sources must be at least 50 microcuries.

   4. Consider using at least one reference source whose activity is within the range of activities normally assayed.

   5. Calibration Procedure:

      a. Assay a calibrated reference source at the appropriate setting (i.e., use the Co-57 setting to assay Co-57), and then remove the source and measure background. Subtract background from the indicated activity to obtain the net activity. Record this measurement. Repeat for a total of three determinations.

b. Average the three determinations. The average value should be within 5 percent of the certified activity of the reference source, mathematically corrected for decay.

c. Repeat the procedure for other calibrated reference sources.

d. If the average value does not agree, within 5 percent, with the certified value of the reference source, the dose calibrator may need to be repaired or adjusted. The regulation requires repair or replacement if the error exceeds 10 percent.

e. At the same time the accuracy test is done, assay the source that will be used for the daily constancy test (it need not be a certified reference source) on all commonly used radioisotope settings. Record the settings and indicated millicurie values with the accuracy data.

f. Put a sticker on the dose calibrator that says when the next accuracy test is due.

2. The Radiation Safety Officer must review and sign records of all accuracy, linearity, and geometrical tests.

APPENDIX H

Radiation Therapy / Oncology Quality Management Program

University of Mississippi Medical Center / Cancer Institute

Radiation Oncology

QUALITY MANAGEMENT PROGRAM

For Administration of Radiopharmaceutical, Brachytherapy, and External Beam Radiation Therapy

A. **OBJECTIVE:** The objective of this Quality Management Program (QMP) is to provide high confidence that radioactive material or radiation from radioactive sources or external beam sources will be administered as directed by the authorized user and thereby eliminate misadministrations and recordable events.

B. **AUTHORITY AND RESPONSIBILITY:** The authority and responsibility to establish and implement this Quality Management Program shall be given to the Department of Radiation Oncology and to the Radiation Safety Office. Directives contained herein are added to existing Department Procedures and the facility ALARA Program.

C. **POLICY:** This policy is for the administration of radiopharmaceuticals, brachytherapy, and external beam radiation therapy at UMMC.

A written directive means an authorized user's written order for the administration of radioactive material or radiation from radioactive material or a therapeutic radiation machine to a specific patient or human research subject.

Electronic signatures from the authorized user on the written directive are only acceptable for therapeutic radiation machines.

1. A written directive must be dated and signed by an authorized user **prior** to administration of I-131 sodium iodide greater than 30 uCi, any therapeutic dosage of radioactive material, or any therapeutic dose of radiation from radioactive material or external beam.

2. The written directive must contain the patient's name and the following information:

    a. For an administration of a radiopharmaceutical: the pharmaceutical, isotope, dosage, and route of administration.

    b. For external beam radiation therapy: the treatment site, total dose, dose per fraction, number of fractions or overall treatment period.

    c. For high dose rate remote afterloading brachytherapy: the treatment site, radionuclide, dose per fraction, number of fractions, and total dose.

    d. For sealed source brachytherapy:

        (1) Prior to implantation: the treatment site, radionuclide, and dose; and

(2) After implantation but prior to the completion of the procedure: the treatment site, radioisotope, number of sources, and total source strength and exposure time (or, the total dose).

Note: The above mentioned information is recorded on the patient's treatment chart and is summarized on the formal report completed by the authorized user caring for this patient.

3. Except in emergency situations, no radiation dose shall be administered by any personnel in the absence of a signed written directive containing the above elements.

4. A written revision to an existing written directive may be made provided that the revision is dated and signed by an authorized user prior to the administration of: the dosage of radiopharmaceutical, the brachytherapy dose, the external beam radiation therapy dose or next fractional dose.

5. If, because of the emergent nature of the patient's condition, a delay in order to provide a *written directive* would jeopardize the patient's health, an oral directive shall be acceptable, provided that the information contained in the oral directive is documented as soon as possible in the patient's record and a written directive is prepared and signed by the authorized user within 24 hours of the oral directive.

6. If, because of the patient's condition, a delay in order to provide a *written revision to an existing written directive* would jeopardize the patient's health, an oral revision to an existing written directive shall be acceptable, provided that the oral revision is documented as soon as possible in the patient's record and a revised written directive is signed by the authorized user within 48 hours of the oral revision.

7. Each administration must be in accordance with the written directive.

8. Specific details of the administration and related calculations of the final treatment plan must be in accordance with the written directive.

9. Both manual and computer generated dose calculations must be checked for accuracy.

10. Computer generated dose calculations must be correctly transferred into the consoles on the therapeutic medical units (HDR or accelerator).

11. Any unintended deviation from the written directive shall be identified and evaluated so that appropriate action can be taken. The Radiation Safety Office will be notified of the deviation.

12. Records of the written directives shall be retained for a period of three (3) years.

13. Prior to administration of a radiation therapy, the patient's identity shall be verified by more than one method as the patient named in the written directive. The person responsible for administering the radiation will complete the verification by at least two of the following methods:

a. Asking the patient to state his/her name,

b. Comparing patient to a recent photograph of same,

c. Asking the patient to state his/her birth date,

d. Asking the patient to state his/her Social Security Number,

e. Asking the patient to state his/her address,

f. Asking the patient for identification such as a driver's license, Social Security card, or similar,

g. Checking the patient's wrist identification band for name, birth date, or UMMC ID number, or

h. For patients unable to respond, an accompanying relative or friend may attest to the identity.

Documentation of the verification of the patient's identity shall include the two (2) forms with which the patient was identified, the date of the identification, and the name of the person making the identification. This record will be maintained for three (3) years. The determination of which two identifiers to use shall be based on departmental policy that complies with all regulatory entities applicable to the Radiation Oncology treatment program.

If the information obtained from any two of these methods does not correspond to the information on the written directive, the radiation dose **SHALL NOT** be administered until conclusive verification of the patient's identity is obtained.

14. A Medical Physicist or Medical Dosimetrist and Radiation Therapist shall read the written directive before preparing or administering the radiation dose. If any portion of the written directive is unclear, he/she must contact the specific authorized user who provided the written directive for clarification. Any unusual fractionation pattern will precipitate a discussion between all parties involved to assure complete understanding of the written directive and corresponding treatment plans.

    a. The radiation dose shall not be administered until the intent of the written directive is thoroughly understood by the Medical Physicist or Medical Dosimetrist and Radiation Therapist. If the person reviewing the dose is different from the person administering the dose, both shall read and understand the written directive.

    b. The Medical Physicist or Medical Dosimetrist and Radiation Therapist shall verify that the specific details of the administration (i.e., isotope, treatment site, procedure, total dose, number of fractions) are in accordance with the written directive.

15. Following the administration of the radiation dose, a dated and signed note shall be entered into the patient's treatment chart documenting the administration and dosage. Any therapeutic administration must be recorded into the patient's

permanent medical record. These records must be retained for at least three (3) years.

16. Department procedures shall contain protocols for all radiopharmaceutical, brachytherapy, and external beam radiation therapies and be available for review. A Medical Physicist or Medical Dosimetrist and Radiation Therapist shall refer to the protocols during any non-routine procedure or in any case in which the protocol is not completely familiar to them.

17. The Department Chair shall approve any change in protocol before that change is implemented and always before the change is incorporated into the procedure manual. Medical Dosimetrist and Radiation Therapists shall be instructed in the change before it is implemented. The Medical Physicist shall review and approve the policy and procedure manual on a yearly basis.

18. If a deviation from the written directive is identified, such as a misadministration or recordable event, an investigation of the incident shall be made. Documenting and reporting of the unintended deviation shall be in accordance with the reporting requirements of the “Regulations for Control of Radiation in Mississippi”.

    Recordable Event: The Radiation Safety Office shall be contacted immediately upon determination that a recordable event has occurred.

    Within 30 days after discovery of any recordable event, the following shall be done:

    a. Assemble the relevant facts including the cause of the event;

    b. Identifying what, if any, corrective action is required to prevent recurrence; and

    c. Retaining a record, in auditable form, for three (3) years, of the relevant facts and what corrective action was taken.

    Misadministration: The Radiation Safety Office shall be contacted immediately upon determination that a misadministration has occurred.

    The MS State Department of Health/Division of Radiological Health (MSDH/DRH) shall be notified by telephone no later than the next calendar day after discovery of the misadministration.

    The Radiation Safety Office will submit a written report to MSDH/DRH within 15 days after discovery of the misadministration.

    The written report shall include: the university's name and department; the prescribing physician's name; a brief description of the event; why the event occurred; the effect on the patient; the actions taken or planned to prevent recurrence; certification that UMMC has notified the patient or the patient's responsible relative or guardian, and if not, why not, and what information was provided to the patient. The report may **not** include the patient's name or other information that could lead to identification of the patient.

The authorized user shall provide notification of the misadministration to the referring physician and also notify the patient or a responsible relative or guardian no later than 24 hours after its discovery, unless the referring physician personally informs the authorized user either that he or she will inform the patient or that, based on medical judgment, telling the patient would be harmful. The authorized user is not required to notify the patient without first consulting with the referring physician. If the referring physician or the patient cannot be reached within 24 hours, they shall notify the patient as soon as possible thereafter. Radiation Oncology may not delay any appropriate medical care for the patient, including any necessary remedial care as a result of the misadministration, because of any delay in notification.

If the patient was notified, a written report will be furnished to the patient within 15 days after discovery of the misadministration. The report will either be a copy of the report that was submitted to MSDH, or a brief description of both the event and the consequences as they may affect the patient. If a letter describing the event and the consequences, not the report submitted to MSDH, is sent to the patient, it will include a statement to the effect that a copy of the report submitted to MSDH will be made available to the patient if requested. A copy of this report shall be provided to the referring physician within 15 days after discovery of the misadministration.

Radiation Oncology shall retain a record of each misadministration for five (5) years. The record must contain: the university's name and department; the names of all individuals involved including the prescribing physician, allied health personnel, the patient, and the patient's referring physician; the patient's Social Security Number or medical record number; a brief description of the event; why it occurred; the effect on the patient; the actions taken or planned to prevent recurrence; whether the authorized user notified the patient or their responsible relative or guardian and if not, whether such failure to notify was based on the guidance from the referring physician.

D. ANNUAL REVIEW: There shall be an annual review of the Quality Management Program to determine its effectiveness.

1. The review will include, from the previous 12 months, a randomly selected representative sample of patient administrations, all recordable events, and all misadministrations.

    a. For each patient case reviewed, a comparison shall be made between what was prescribed in the written directive and what was actually administered. It shall be determined whether the administered radiation dose was in accordance with the written directive in terms of treatment site, procedure, isotope, fractional dose or total dosage.

    b. For each patient case reviewed, any deviations from the written directive shall be identified along with the cause of each, if possible, and the action taken to prevent recurrence.

    c. When a recordable event or misadministration is uncovered during the periodic review of the QMP, the number of cases included in the review will be expanded.

2. The records of each review will be retained for three (3) years. These records shall be available for inspection by the MSDH/DRH. The results of the annual review will also be distributed to appropriate management officials.

3. Following the annual review the Radiation Safety Committee will determine if the policies and procedures of the Quality Management Program are effective or require modification. Any modifications in the QMP will be submitted to the MSDH/DRH within 30 days after the modifications have been made.

E. IMPLEMENTATION: The policies and procedures specified in this document will be implemented upon approval by the Radiation Safety Committee.

_____ _____

Chair, Radiation Safety Committee Date

_____ _____

Chairman, Radiation Oncology Date

_____ _____

Radiation Safety Office Date

Reporting Requirements for Radiation Oncology

Recordable Event

1. Administration of an external beam radiation therapy dose when the calculated weekly administered dose is 15 percent greater than the weekly prescribed dose.

Misadministration

1. Administration of an external beam radiation therapy dose:

    a. Involving the wrong patient, wrong treatment modality, or wrong treatment site;

    b. When the treatment consists of three or fewer fractions and the calculated total administered dose differs from the total prescribed dose by more than 10 percent of the total prescribed dose;

    c. When the calculated weekly administered dose is 30 percent greater than the weekly prescribed dose; or

    d. When the calculated total administered dose differs from the total prescribed dose by more than 20 percent of the total prescribed dose.

2. Other than events that result from intervention by a patient, Radiation Oncology shall report any event in which the administration of radioactive material or radiation from radioactive material results in:

    a. A dose that differs from the prescribed dose by more than 5 Rem effective dose equivalent, 50 Rem to an organ or tissue, or 50 Rem shallow dose equivalent to the skin; and either:

        (1) The total dose delivered differs from the prescribed dose by 20 percent or more;

        (2) The total dosage delivered differs from the prescribed dosage by 20 percent or more or falls outside the prescribed dosage range; or

        (3) The fractionated dose delivered differs from the prescribed dose, for a single fraction, by 50 percent or more.

    b. A dose that exceeds 5 Rem effective dose equivalent, 50 Rem to an organ or tissue, or 50 Rem shallow dose equivalent to the skin from any of the following:

        (1) An administration of a wrong radiopharmaceutical;

        (2) An administration of a radiopharmaceutical by the wrong route of administration;

(3) An administration of a dose or dosage to the wrong individual;

(4) An administration of a dose or dosage delivered by the wrong mode of treatment; or

(5) A leaking sealed source.

c. A dose to the skin or an organ or tissue other than the treatment site that exceeds by 50 Rem to an organ or tissue and 50 percent of the dose expected from the administration defined in the written directive (excluding, for permanent implants, seeds that were implanted in the correct site but migrated outside the treatment site).

3. Radiation Oncology shall report any event resulting from intervention of a patient in which the administration of radioactive material or radiation from radioactive material results, or will result in, unintended permanent functional damage to an organ or a physiological system, as determined by a physician.

APPENDIX I

Instructions for Brachytherapy

Detailed Instructions for Attending Brachytherapy Patients

1. Attendants shall not give nursing care to a brachytherapy patient until they have read these precautions!

2. Only personnel necessary to the care of this patient shall enter the patient's room while the sources are in place.

3. No declared pregnant attendants or nurses are allowed to attend the patient while the brachytherapy sources are implanted in the patient.

4. No attendants less than 18 years of age.

5. Attendants and nurses shall wear personal dosimetry devices, pocket ion chambers, or an electronic alarming dosimeter provided by the Radiation Safety Office.

   Note: If personal dosimetry devices are provided, they cannot be exchanged between personnel. Each device is assigned to one person to be worn by that person only.

6. Observe the posted time limits. Nurses shall spend only the minimum time necessary near a patient for routine nursing care. Special restrictions will be noted on the precaution sheet on the patient's chart.

7. Patients shall occupy a private room (unless approved by the Medical Physicist).

8. Brachytherapy patients must stay in bed unless orders to the contrary are written. In any event, patients will remain in their assigned rooms during the entire treatment period.

9. Bed baths shall not be given while the sources are in place. After the sources have been removed bed baths will be permitted.

10. Do not change bed linens, packing, surgical dressings, or perineal pads while the sources are in place. All bed linens, dressings and other waste material from the patient must be monitored with a survey meter before they are removed. This will ensure that no dislodged source is disposed of accidentally. The Medical Physicist or the Radiation Safety Office must monitor items away from the patient's bed - an area with low background radiation levels - prior to release from the patient's room. (Only food trays are permitted to leave the room without a survey.)

11. Do not allow the room to be cleaned by Hospital Housekeeping Services. The trash cannot be emptied, the floors cannot be swept until all sources have been removed and accounted for.

12. Before the patient may be discharged and the room released for another patient, a dismissal survey must be performed by the Medical Physicist or the Radiation Safety Office.

13. The physician caring for each patient may institute certain restrictions specific for a particular type of brachytherapy. Read these instructions prior to caring for any brachytherapy patient.

EMERGENCY PROCEDURES

Never touch needles, capsules, or containers holding brachytherapy sources. If a source becomes dislodged, **do not touch it or pick it up with your hands**.

A. If the applicator or sources fall out:

1. Using long forceps, place the applicator immediately into the lead container in the corner of the room.

2. If only the sources fall out, follow the same procedure as in item (1.) above.

3. Record the time on the Intracavitary Application Sheet.

4. Immediately notify the physician in charge of the case, the Medical Physicist (Extension 42550), and the Radiation Safety Office (Extension 41980, On Line On-Call Schedule or Emergency Dispatch at extension 41420).

B. If the patient dies or requires emergency procedures, immediately notify the physician in charge of the case, the Medical Physicist and the Radiation Safety Office.

VISITOR PRECAUTIONS

1. No pregnant visitors. Female visitors must be asked whether or not they are pregnant.

2. No visitors less than 18 years of age.

3. Visitors must maintain a distance of 3 feet or greater from the patient and limit visitation time as specified in the order provided to the nurses by the Medical Physicist for each individual patient.

Whenever in doubt as to a correct radiation procedure, ask before you act. Contact the Radiation Oncology Department at 984-2550 and speak with the Medical Physicist or contact the Radiation Safety Office at 984-1980 and speak with the Radiation Safety Personnel.

APPENDIX J

HDR Emergency Procedures

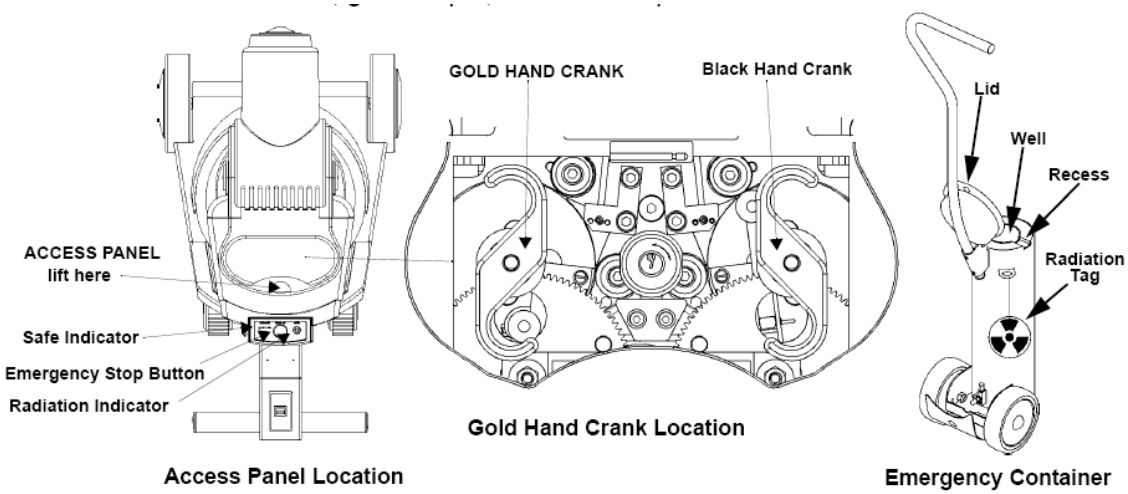
EMERGENCY PROCEDURES

FOR microSelectron-HDR (-GENIE) IF THE SOURCE FAILS TO RETURN TO THE SAFE

1. Press the RED EMERGENCY STOP BUTTON on the treatment control panel. If the source retracts and the radiation indicator light is off, go to step 7, otherwise step 2.

2. Enter the treatment room.

- Lift the ACCESS PANEL on top of the treatment unit to access the GOLD HAND CRANK. Turn it in the direction of the arrows (on the hand crank) until it blocks.
- If the source retracts, go to step 7, otherwise step 3.



3. Check the patient for radiation. If detected, remove the applicator* from the patient, ensuring that radiation is confined to the applicator. Open the lid of the Emergency Container. Insert the applicator containing the source into the well, using long forceps. Guide the transfer tube through the recess at the container edge. Close the lid. Leave the radiation warning tag hanging outside the container, to indicate it contains radioactive material.

4. IMMEDIATELY assist the patient from the room.

5. Ensure that the applicator and source are safely stored inside the emergency container.

6. Leave the room. Close the door. Mark it NO ENTRY. Note: The emergency container cannot be considered as a storage container. When a radioactive source is in the container, the source shielding is insufficient for storage in a treatment room with restricted access.

7. Retain the treatment data printout and contact the following:

Authorized User:	Srinivasan Vijayakumar	Tel: 601 815 6868
Authorized Medical Physicist:	Claus Yang	Tel: 601 815 7562
Facility RSO:	Robert Nelson	Tel: 601 984 1989
On Call Radiation Safety:	(Emergency Dispatch)	Tel: 601 984 1420

Nucletron Representatives:

RSO:	Debra Bensen	Tel: 410-913-3162
Technical Support Toll Free:		Tel 1-855-MYELEKTA (693-5358)

The unintended radiation dose to which those present have been subjected should be estimated and recorded by a suitably qualified person.

*See section 2.9.5.2 of the User Manual when a Single Leader Button-end Flexible Implant Tube is used.

APPENDIX K

Procedure for Decommissioning Liquid Scintillation Counters

Procedure for Decommissioning Liquid Scintillation Counters

Purpose and Scope: This procedure details the process of decommissioning of liquid scintillation counters (LSC). Included are good health physics practices for the disassembly, removal of lead, removal of sealed sources, proper handling, and storage of the seal source. This procedure can only be performed by a manufacture representative or Radiation Safety personnel.

During disassembly good health physics practices will be utilized. The unit will be surveyed for contamination before the decommissioning process begins. Proper PPE including, but not limited to, gloves, lab coat, tongs, and all appropriate dosimetry including finger ring(s) will be worn. A calibrated survey meter will be present and used during the decommissioning. The unit will be surveyed both before and after the decommissioning is complete.

1. Disassembly of the LSC
    a. Ensure that the unit is de-energized.
    b. Removing the outer housing of the unit.
    c. Dismantle the lead shielding around the photomultiplier tubes.
    d. Locate the source safe.
    e. The sealed source and all lead must be removed before disposal of the unit.
2. Removal of Sealed Source
    a. The source and source safe may be removed together and stored as a self-shielded unit; or
    b. The source may be removed for the safe and placed in an appropriate lead pig.
    c. The source should not be handled directly with the hands. Long tongs should be utilized to move the source.
    d. Source information must be transferred to either the lead pig or the removed source safe containing the material.
    e. A survey meter will be used to verify the sources removal from the unit.
3. Storage
    a. The source will be kept shielded in a secure storage area until proper disposal can be arranged.
    b. The source will be transferred from the equipment inventory to the Radiation Safety Office’s sealed source inventory.
    c. The source will be leak tested before transfer or disposal in accordance with DOT regulations.

The lead will either be repurposed or safely stored. Any disposal of lead will be thorough a licensed broker.

APPENDIX L

Procedure for Exchange of Gadolinium-153 Rod Sources in Siemens ECAM Gamma Camera

Procedure for Exchange of Gadolinium-153 Rod Sources in Siemens ECAM Gamma Camera

Purpose and Scope: The procedure details the process of exchanging the partially decayed gadolinium-153 (Gd-153) transmission rod sources in a Siemens ECAM gamma camera. Included are good health physics practices for the removal, rearrangement, replacement, and disposal of sources. This procedure can only be performed by a manufacture representative or Radiation Safety personnel.

During the procedure good health physics practices will be utilized. Proper PPE including, but not limited to, gloves and all appropriate dosimetry including finger ring(s) will be worn. A calibrated survey meter will be present and used during the source transfer.

The transmission sources are arranged in two arrays of fourteen (14) sources each and are mounted to the gamma camera. Two (2) sources in each array will be replaced semi-annually.

Procedure for Source Exchange:

1. The technologist will position the detector 1 array for removal from the gamma camera.
2. Radiation Safety personnel or manufacture representative will remove the array from its housing.
3. The two (2) oldest sources are removed from the array and individually leak tested.
4. The remaining sources are rotated within the array.
5. The two (2) new sources are installed.
6. The entire array is leak tested.
7. The array is then repositioned in the camera housing.
8. The technologist will position the detector 2 array for removal from the gamma camera, and steps 2 through 7 are repeated.
9. The technologist will perform QC tests of the transmission sources.

The four (4) removed sources are shipped according to DOT regulations to the manufacturer for disposal. Sources are removed from inventory once the source disposal receipt is received from the manufacturer.